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Vol. xv OCTOBER, 1910 No. 10

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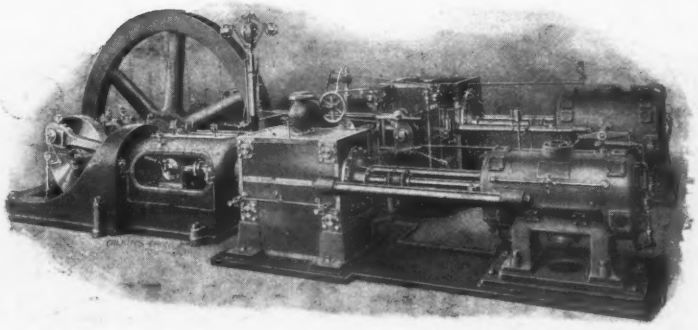

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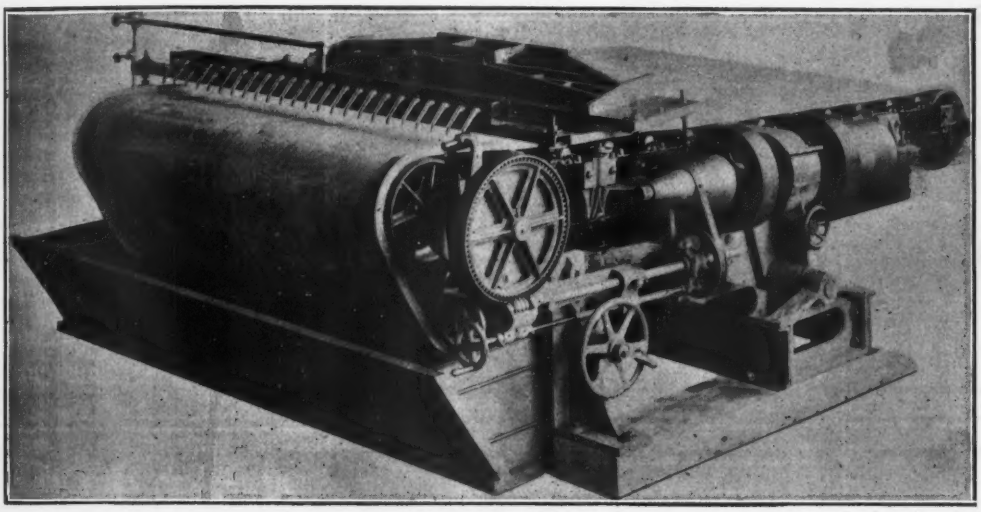

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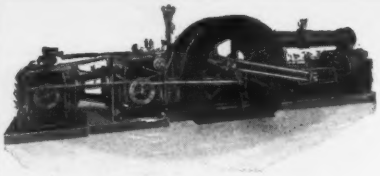

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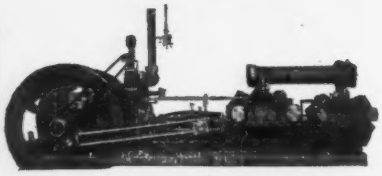

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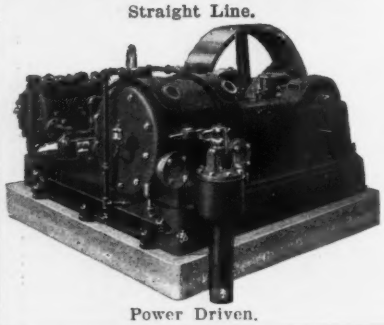

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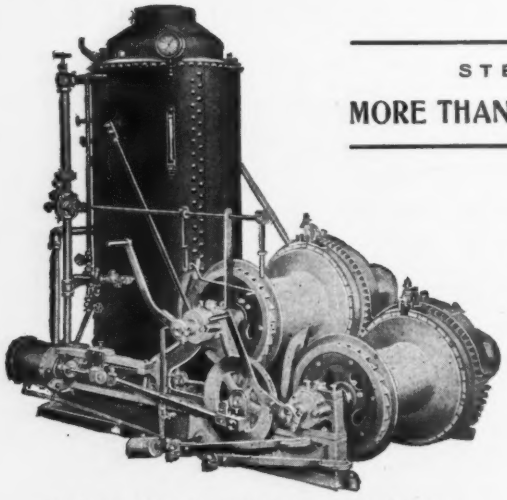

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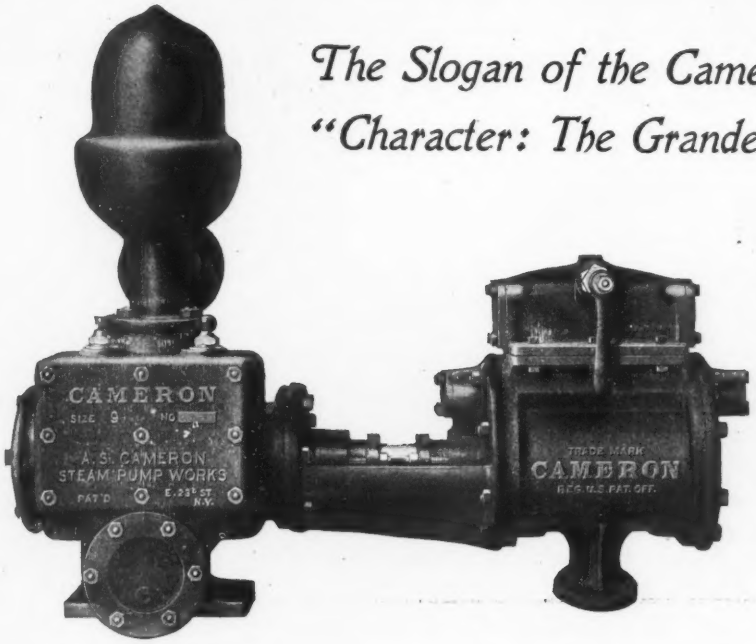

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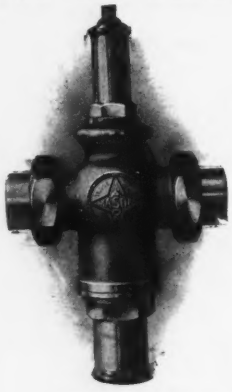

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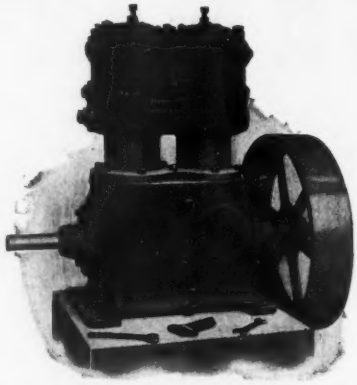

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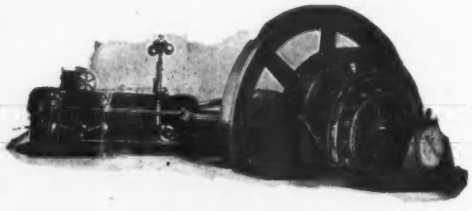

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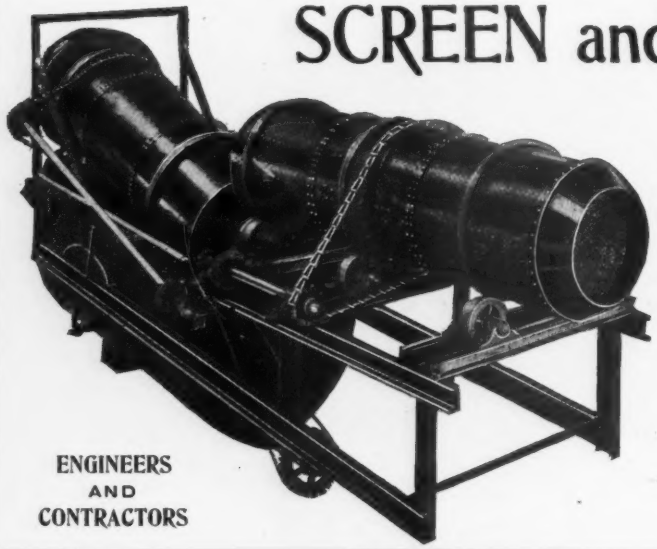

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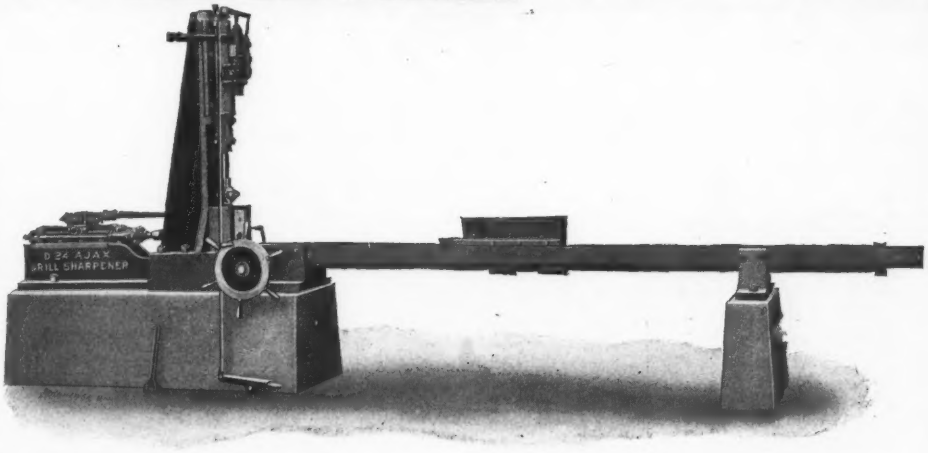

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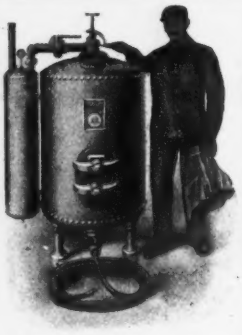

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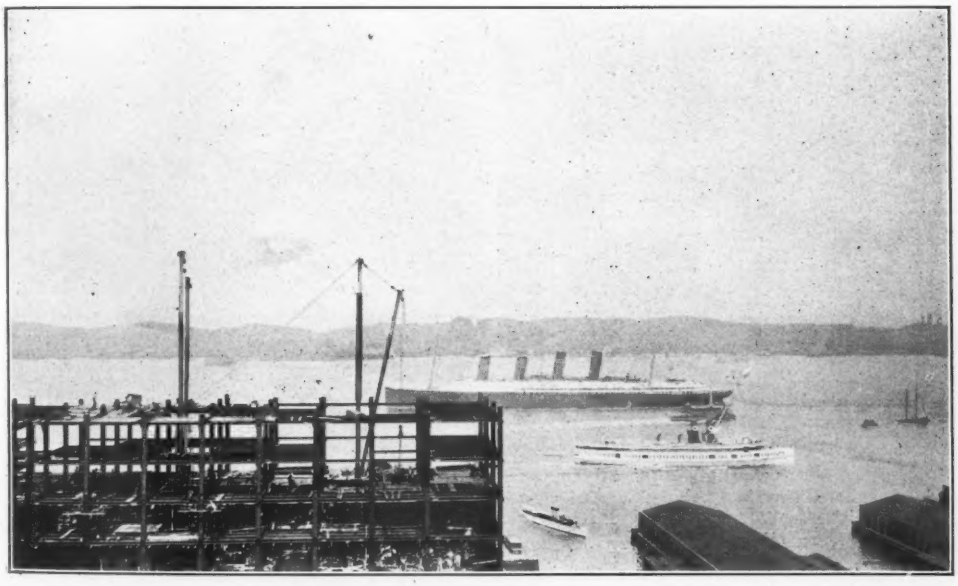
EVERYTHING PNEUMATIC.

Vol. XV OCTOBER, 1910. No. 10

THE LATEST AND LARGEST OFFICE BUILDING

An interesting, but to us not an altogether welcome event, of the summer just passed, has been the running up of the latest of the great office buildings of New York before the editorial window, thus partially shutting off our view of the North River and its endless flow of busy craft coming and going. The building is at present known as the Annex to the Whitehall Building. In the picture on the following page, Fig. 2, from the architects drawing, the smaller building—it is only twenty stories—at the right, which looks down the Bay, is *the* Whitehall Building, and the larger is the Annex Building, its front facing the North, or Hudson River. Our snapshots Figs. 1 and 3, taken from our fourteenth story window, show the rear of the building.

This structure is one of the many trophies of modern architecture—and we may say also of modern manufacture—to the possibility of whose erection pneumatics has been one of the chief and most necessary contributors. Situated so near the river, the sinking of the caissons through the loose and pervious sand down to the rock was quite comparable to working in an actual diving bell. It was not only necessary to secure foundations for each of the steel columns to carry the great weight of the superstructure, but the entire area of



CUTTING OFF OUR OUTLOOK.

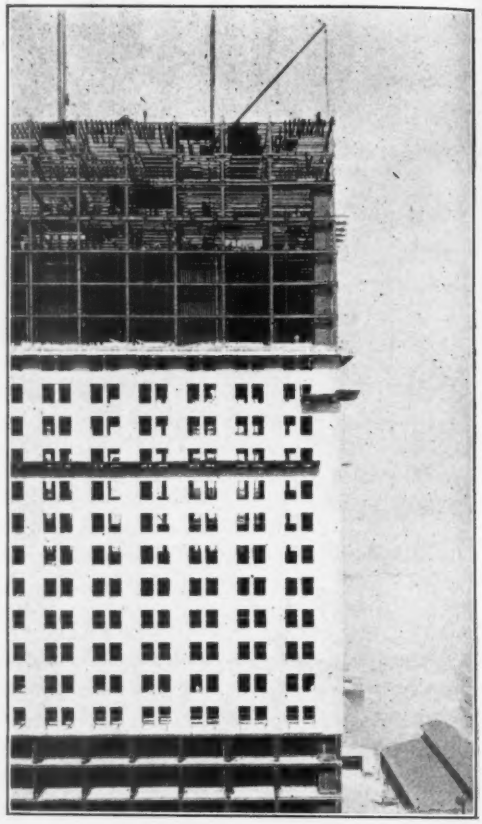
the basement stories, sides and bottom, were to be made watertight and also strengthened to resist the lateral and upward pressure due to the submerged depth.

After the erection of the steel framework began we had the din of the pneumatic riveters all day long. The speed with which the steel frame went up would have been marvelous only that such feats are now the habit. Fig. 3 was taken only three weeks after Fig. 1. While the steel work was going up the walls and flooring crowded along as fast as the opportunity developed. It will be noted that the walls, of light colored brick, begin at the eighth story, the stories below being of stone could be erected later, all being supported by the steel structure within and the old time function of the walls as the support of the building being entirely ignored. As

THE WHITEHALL BUILDING AND ITS ANNEX.

the building is seen in Fig. 3 there were still five stories to be added to complete the height, while several stories are out of the view at the bottom, so that to have got them all in we should have had a panoramic camera, using it vertically.

The Annex is built upon a plot of 51,515 square feet. It is 31 full stories, 415 feet,



BUILDING PART WAY UP.

above the street level and its total cubic capacity is 11,000,000 cubic feet. There are 14,000 tons of structure steel, 7,500,000 of common brick, 900,000 face brick and 3,000 tons of ornamental terra cotta. Within the building there will be 450,000 square feet of partition tile and 120,000 square feet of column covering, 45,000 barrels of cement being used. For the floors there will be 800,000 feet of yellow pine and 80,000 feet of base molding. The boiler equipment of the building will be 21,000 horse power. Space will not permit an enumeration of the mechanical, electrical and miscellaneous equipment.

Butte men won the Ryan $1,000 prize at Calumet, Michigan, July 30 by drilling 53½ inches in granite in 15 minutes. This sets up a new world's record for double-hand drilling, surpassing that of 48¼ inches made at El Paso, Texas, in 1904.

PNEUMATIC CAULKING OF LARGE GAS MAINS

A new and highly satisfactory employment of compressed air operated tools has developed in connection with the laying of a large main crossing the Harlem River, New York, by the Consolidated Gas Company. The pipe is 48 inches in diameter and is laid in a deep trench, as seen in the halftones. The most onerous operation in connection with the laying of such lines as this has hitherto been the caulking of the joints. This has been done by hand, and it has usually been a slow operation, delaying all the work, and the results after all have lacked uniformity and reliability. The most frequent defects have been at the under side of the pipe on account of its inaccessibility. For a single joint of this size two hours and a half were required for the yarning and seven hours for the laying and caulking of the lead wool, or a ten hour day's work of two men for each joint. Three and a half inches of tarred rope was rammed in for the yarning, and this was followed by the lead wool which was finally packed to

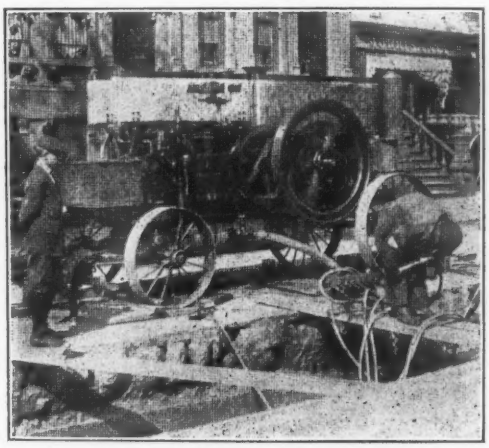


FIG. 1.

two and a half inches, using 160 pounds of lead to the joint.

When pneumatic hammers were put on the job the same proportion of yarn and lead wool were at first used, but under these hammers the lead was packed so much more tightly that 187 pounds of lead wool was required to fill the same space before filled with 160 pounds. The space allowed to be filled with the lead wool was then reduced to 2¼

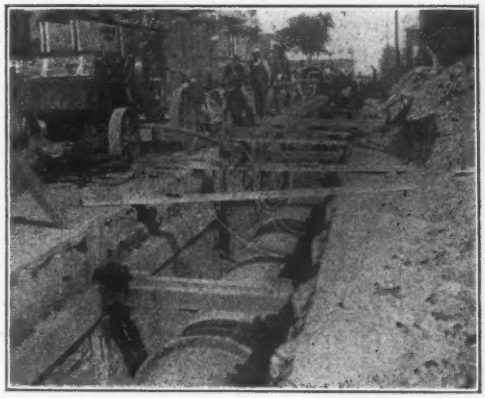


FIG. 2.

inches and about 16 pounds was then used, as with the hand caulking.

The yarning process is still done by hand, and two men are employed on the caulking as before, one on each side. It has become an easy matter to caulk the bottom of the joint, and a uniform packing and tightness is secured all around the pipe.

The labor saving possibilities of these tools as applied to this work are readily seen when the results of this limited trial show that two joints are completely yarned and caulked by two men in a ten hour day, against one joint in the same time by hand.

Ingersoll-Rand Crown Hammers No. 53 were used for this work. These had round bushings which permitted the piston to turn to follow the curve of the pipe without requiring the holding of the drill body in inconvenient positions. The halftone Fig. 1 shows the Ingersoll-Rand portable compressor used, driven by a 15 H. P. Abenaque Gas Engine. A manifold is seen at the edge of the trench to which eight hammers can be connected, so that four joints may be caulked at once. The engine consumes 10 gallons of gasoline a day, or a gallon an hour, maintaining an air pressuresure of about 60 pounds. The halftone was reproduced from Progressive Age. It was found inconvenient to show the tools actually at work upon the pipe.

The function of this gas main is to connect Manhattan and the Bronx, so that it of course crosses the Harlem River, being laid in a deep trench prepared for it under the water. It is especially necessary that this portion of

the line should be tight, not only on account of its absolute inaccessibility but also because the water pressure so much exceeds that of the gas, and water might leak into and accumulate in the pipes. The sections of pipe here rest upon concrete blocks and are held in position by wedges at the sides. In placing the pipe two lengths were placed together and caulked on the deck of the barge and then lowered into position when the alternate joints were packed and caulked by divers. For this work Imperial hammers were found more suitable.

HIGH PRESSURE CYLINDER DIAMETERS FOR AIR COMPRESSORS

[The following article by Mr. J. William Jones, Painted Post, N. Y., we are enabled to reproduce by the kind permission of the editor of *Machinery*, in which it first appeared, the cuts constituting the August contribution to the valuable series of Data Sheet Supplements regularly accompanying that publication. The entire matter is copyrighted by the Industrial Press of New York.]

The charts or diagrams on pages following are intended for the rapid determination of the proper diameters of high pressure cylinders for two stage air compressors. By means of these charts it is possible to find instantly the required high pressure cylinder diameter for various pressures and altitudes, when the low pressure cylinder diameter is known, the latter being determined, usually, by the volume of free air to be compressed in a given time.

Fig. 1 is taken up with condensed instructions as to the methods of using the charts which follow. The first of these charts, Fig. II, is laid out for sea level conditions. The diameter and stroke of the low pressure cylinder are first computed with reference to the required piston displacement, and from this diameter the high pressure cylinder diameter is traced as shown for a single case by the dotted lines and arrows on the chart. These show the method of procedure when the diameter of the low pressure cylinder is 20 inches and the air is compressed to 200 pounds gage pressure. Any ratio between the cylinder diameters found in this way divides the load equally between the two stages, provided the intercooler abstracts all the heat due to the compression in the first stage. The two other charts are laid out for 5,000 and 10,000 feet altitudes, and are otherwise used in the same manner as the first chart.

A problem which often confronts the compressor builder when manufacturing a standard line, is to obtain cylinder ratios which will be approximately correct for various conditions. As an example, assume that it is required to determine the dimensions for the high-pressure cylinder of a compound compressor having a low-pressure cylinder of 30 inches diameter. It is required to find the correct cylinder ratios for 80 to 100 pounds gage pressures for altitudes from sea level up to 5,000 feet. Referring to the sea level chart we find that the proper diameter of the high-pressure cylinder for 80 pounds would be 18 7-8 inches, and for 100 pounds, 18 inches. On the 5,000-foot altitude chart we find that the high-pressure cylinder at this altitude should be 18⅛ and 17¼ inches, for 80 and 100 pounds pressure, respectively. A convenient mean of the above pressures would be 18 inches diameter, which would meet the requirements of the case very satisfactorily.

A table of abstract ratios of compression for various pressures and altitudes is given in Fig. I, with all necessary instructions as to the use of the charts. As a final example, assume that a given compressor requires a low pressure cylinder 33 inches diameter, and that it is required to find the high pressure cylinder diameter for compressing air to 100 pounds, gage, at sea level. The operation will be as follows:

$$d = \sqrt{\frac{33^2}{\sqrt{\frac{14.7 + 100}{14.7}}}} = 19.75 \text{ inches.}$$

This calculation is somewhat lengthy, and the charts here given will be found very convenient in such cases in that they give the diameter directly without any calculation.

In the Newcastle, England, district in 1909 the total of coal cut by electrical coal cutters was 468,067 tons, and by compressed air 767,114 tons, there being in use 45 electric machines and 178 air machines.

HIGH-PRESURE CYLINDER DIAMETERS FOR AIR COMPRESSORS—I.

Method of Using the Accompanying Charts.

The diameters of high-pressure cylinders for compound air compressors are found instantly from the accompanying charts for varying pressures and altitudes, when the low-pressure cylinder diameter and the stroke have first been computed with reference to the required piston displacement. The dotted lines and arrows in the diagrams indicate the procedure when the diameter of the low-pressure cylinder is 20 inches and the air compressed to 200 pounds gage pressure. The ratio between the cylinder diameters so found divides the load equally between the two stages, provided the intercooler abstracts all the heat due to compression in the first stage.

The ratios of cylinder areas in the charts are obtained from the absolute ratio of compression.

Example: Compression of 150 pounds gage pressure required.

Absolute pressure = 150 + 14.7 = 164.7 pounds.

Absolute ratio of compression = 164.7 ÷ 14.7 = 11.2.

The square root of this ratio is the ratio of the low-pressure piston area to the high-pressure piston area, or

$$\sqrt{11.2} = 3.35 = \text{ratio of cylinder areas.}$$

A table of absolute ratios of compression for various pressures and altitudes is given below:

Table of Absolute Ratios of Compression.

Gage Pressure, Pounds	Absolute Ratio of Compression		
	Sea Level	5000 feet	10000 feet
80	6.44	7.55	8.92
100	7.80	9.20	10.90
125	9.50	11.25	13.40
150	11.20	13.30	15.90
200	14.60	17.40	20.80
250	18.00	21.50	25.80
300	21.40	25.60	30.70

The general formula for determining the high-pressure cylinder diameter is:

$$d = \sqrt{\frac{D^2}{\sqrt{\frac{P_1 + P_2}{P_1}}}}$$

in which d = diameter of high-pressure cylinder,

D = diameter of low-pressure cylinder,

P_1 = initial pressure,

P_2 = terminal gage pressure.

WHY THE DRIED BLAST PAYS.

BY PROF. JOSEPH W. RICHARDS, SOUTH BETHLEHEM, PA.

The higher maximum temperature of the furnace gases in the smelting zone (region of the tuyeres) is the sole and the sufficient reason for the advantages produced by drying the blast. Removing the moisture of the blast results in saving the heat formerly required for its decomposition, and enables the furnace gases to attain a higher maximum temperature of combustion. The higher maximum temperature of the furnace gases quickens the rate of transfer of the necessary smelting heat to the slag and pig iron, and thus increases the rate of smelting.

The smelting down of slag and pig iron to the liquid and superheated state requires to have added to those materials, at a temperature at and above their melting points, their latent heats of fusion and the sensible heat of superheated liquid material. This is the principal thermal work done in the smelting zone of the furnace. It can only be accomplished by the agency of furnace gases possessing maximum temperatures far above the melting points of these materials, and is accomplished only by the sensible heat which these gases are able to give out in cooling down from their maximum temperature to the melting points of the slag and iron.

THE GAIN IN EFFECTIVE SMELTING HEAT.

The sensible heat which the furnace gases possess above the melting points of the slag and iron is therefore the only effective smelting heat which they possess, and is a direct measure of their smelting capacity. Any rise in the maximum temperature of the furnace gases increases in a large proportion the part of their sensible heat available above this necessary smelting temperature and thus increases largely their smelting power. When the smelting power of the carbon burned in the tuyere region is increased, more iron and slag can be smelted per unit of carbon there oxidized, and therefore the fuel consumption in the smelting zone is greatly decreased per unit of pig iron produced. This decrease of carbon consumption in the smelting zone does not necessitate the use of more carbon for reducing purposes in the upper part of the furnace, because there is ordinarily produced in the smelting region by the oxygen of the blast such a large excess of CO gas that only a small fraction of it can be possibly used up in reducing the ore. The poor ratio of CO^2 to CO in the gases of the ordinary furnace is not due to imperfect reduction of ore by CO, but to the fact that such a great excess of CO gas is formed in the tuyere region that the oxygen of the ore can only convert a small fraction of this CO into CO^2.

The smaller amount of carbon consumed in the tuyere zone when using dried blast is therefore more perfectly changed into CO^2 in the upper part of the furnace, during the reduction of the ore, and therefore gives greater thermal service in the furnace per unit of carbon consumed. This improvement in the ratio of CO^2 to CO in the throat gases is a direct result of the smaller carbon requirement in the smelting region.

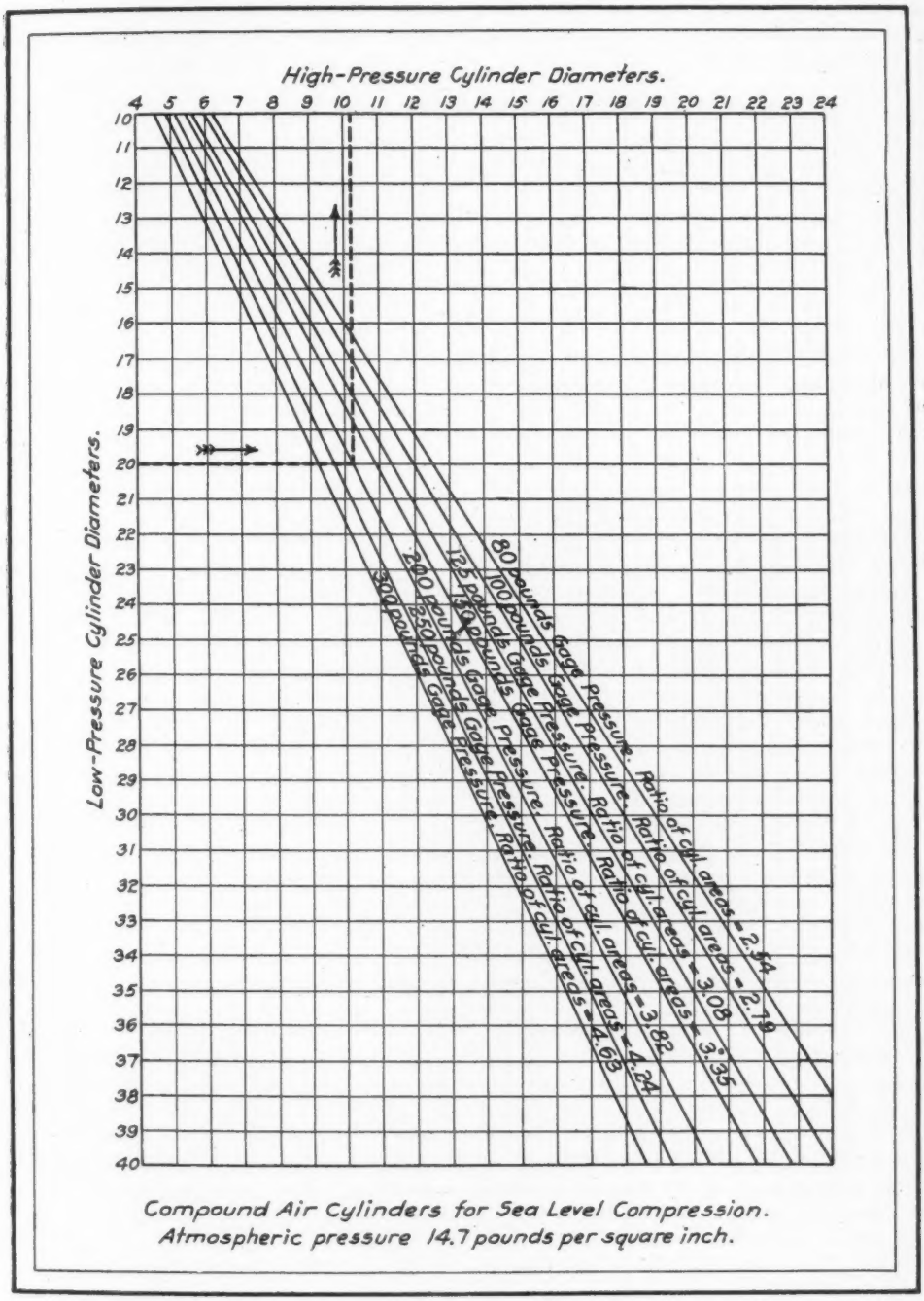
The smaller amount of carbon consumed per unit of pig iron, or of burden charged, results in a smaller volume of CO and N^2 gases rising through the furnace per unit of burden. They therefore perform reduction more thoroughly, and become cooler before leaving the furnace. While, therefore, the smelting zone is working hotter, the upper part of the furnace works cooler. Since the furnace works faster, the radiatrix and conductrix losses per day being no higher or even less than before, these losses expressed per unit of output become lessened. Since less blast is required per unit of product, the stoves can heat it hotter and the blowing engines have less work to do, unless the blast is kept constant and the output increased to its maximum. In any case, the blowing engine power per unit of output is decreased.

REGULARITY AND UNIFORMITY.

Besides these direct results of the higher temperature in the tuyere region, there are secondary advantages of removing or rendering uniformly low the moisture in the blast, which are of great value to the management of the furnace. These are the regularity of running, of output, of fuel consumption and of grade of pig iron produced. The manager does not have to fear sudden changes in the quality of iron produced, nor to carry an excess of fuel in the furnace charge in order to

*A paper read at the International Congress of Mining and Metallurgy, Dusseldorf, Germany, June, 1910.

HIGH-PRESSURE CYLINDER DIAMETERS FOR AIR COMPRESSORS—II.


High-Pressure Cylinder Diameters.
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Low-Pressure Cylinder Diameters.
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
80 pounds Gage pressure. Ratio of cyl. areas = 2.54
100 pounds Gage Pressure. Ratio of cyl. areas = 2.79
125 pounds Gage Pressure. Ratio of cyl. areas = 3.08
150 pounds Gage Pressure. Ratio of cyl. areas = 3.35
200 pounds Gage Pressure. Ratio of cyl. areas = 3.82
250 pounds Gage Pressure. Ratio of cyl. areas = 4.24
300 pounds Gage Pressure. Ratio of cyl. areas = 4.63

Compound Air Cylinders for Sea Level Compression.
Atmospheric pressure 14.7 pounds per square inch.

provide against such unforseen changes. This regularity gives such great relief to the manager that the practical man may well count it as the chief advantage, as far as he is concerned of using the dried blast.

But uniformity and regularity are only one side of the advantages of dried blast; the other side is the economy resulting directly from the absence of high moisture and the consequent high temperature in the tuyere region. Regular and uniform running at high efficiency is the combination which in its entirety has made such a great advance in practical blast furnace running with dried blast.

REASONS FOR INCREASED OUTPUT

With dry air blown upon incandescent carbon, the maximum temperature of the gaseous products of combustion, CO and N^2, will be 1678 degrees for cold blast, and 84 degrees hotter for every 100 degrees that the blast is heated. With moisture present in the blast, these temperatures may be reduced as much as 235 degrees when the air is warm and saturated with moisture, giving a theoretical maximum temperature of only 1,443 degrees with unheated blast. Details of these calculations, and tabulation of temperatures for various atmospheric conditions and temperatures of blast may be found in the writer's "Metallurgical Calculations," Part II, pp. 282-286. As an illustration, if the outside air carries 40 g. of moisture per cubic meter and the blast is heated to 500 degrees, the maximum temperature of the gases of combustion in the tuyere region is 1,848 degrees; while if the moisture is reduced to 5 g., and the blast temperature is unchanged, the maximum gas temperature rises to 2,061 degrees.

Assuming a smelting temperature of 1,250 degrees as required while melting is being performed, the first case gives an excess, or temperature head, of 598 degrees, available to transfer heat to the charge as it is being smelted; the second case gives an excess of 811 degrees, or an increase of temperature head of 213 degrees, or 36 per cent. Under these conditions, the furnace would smelt down charge approximately 36 per cent. faster with the dried blast than with the moist. Admittedly, these atmospheric conditions are extremes: The average increase on the Atlantic Coast of the United States has been 15 to 20 per cent. for the year's running. The three blast furnaces producing the largest number of tons of pig iron in 1909 in the United States were all three running on dried blast.

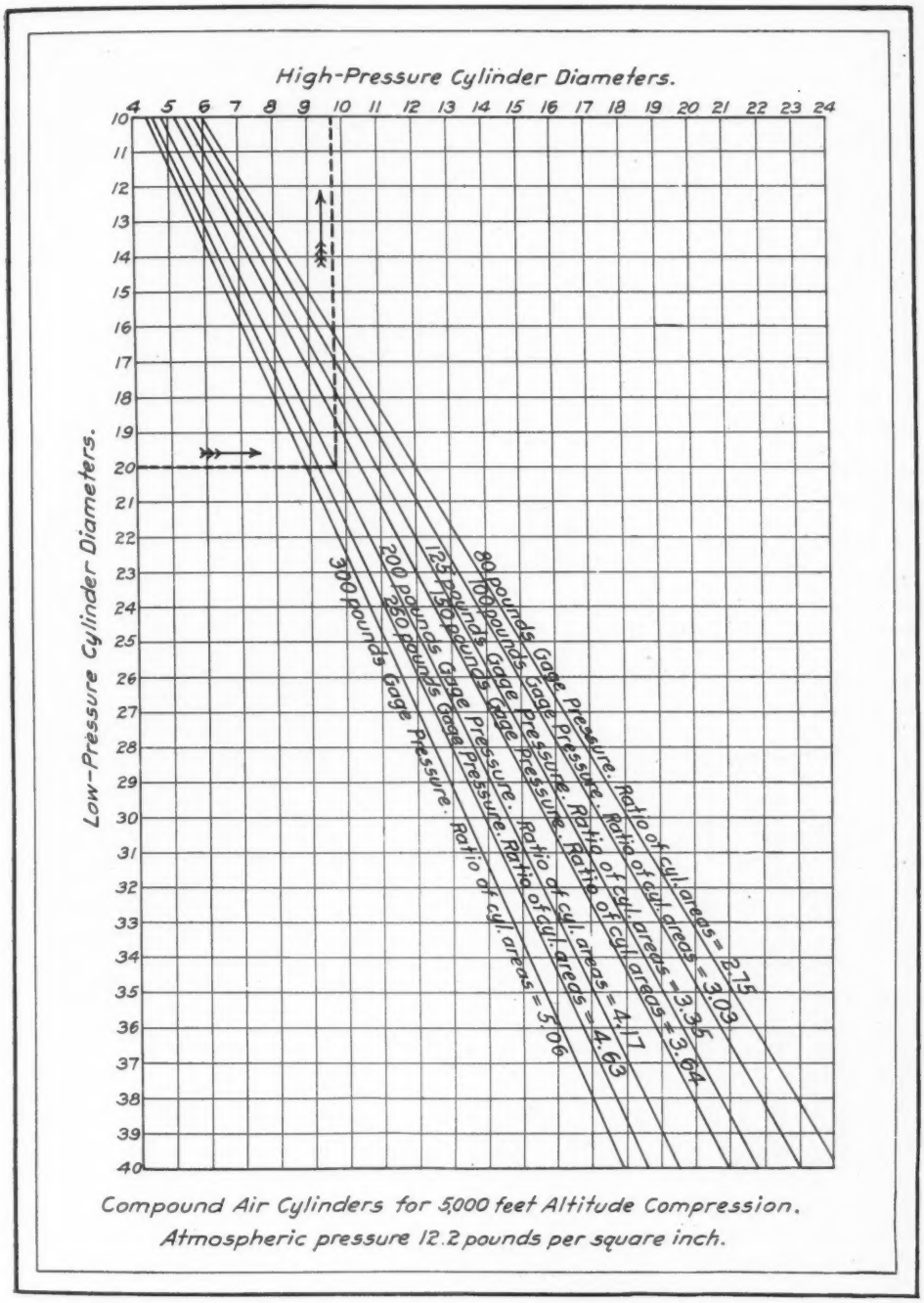
The increased smelting power per unit of carbon burned in the tuyere region, when using dried blast, is also calculable. When a kilogram of carbon is burned to CO, it evolves 2430 calories; if the blast necessary is preheated, there is added to this the sensible heat in the blast. The total available smelting heat per kilogram of carbon, using dry air blast, can be thus calculated:

Temperature of blast.	Available heat.
0 degrees	2,430 cal.
300 degrees	2,847 cal.
600 degrees	3,286 cal.
900 degrees	3,746 cal.

If, however, moisture is present, it rapidly absorbs heat and reduces the available heat in the smelting region. Its effect is, therefore, to leave less heat available at a lower initial maximum temperature. Taking again the example of blast at 500 degrees and air with 40 g. of moisture to the cubic meter, the total heat available is 3137 calories from combustion and the blast, diminished by 574 required to decompose the water vapor, leaving only 2563 calories available. The calories available for smelting purposes in the tuyere region is thus decreased 18 per cent. by the presence of the moisture. Remove this moisture, and the weight of carbon necessary to be burned in the tuyere region to do a given amount of smelting work will be reduced 18 per cent.; *i. e.*, the fuel requirement of the furnace will be reduced at least 18 per cent., calculating per unit of output. Other incidental advantages will increase the saving even above the calculated 18 per cent.

If less carbon is burned in the tuyere region per unit of output, the oxygen from the solid charges given out by reduction, and which is fixed in amount, will produce a relatively greater proportion of CO^2 in the issuing gases. This means that a greater proportion of the CO formed will be converted into CO^2, and therefore a greater utilization in the furnace of the calorific power of the carbon of the fuel. For example: If in a given furnace 75.3 kg. of carbon is burned at the tuyeres to CO, producing there 175 kg. of CO, and the solid charges give up in being reduced 41.8 kg. of oxygen, this can convert 73.15 kg. of CO into CO^2, and the total heat of oxydation of the carbon to this proportion of CO and CO^2 can

HIGH-PRESSURE CYLINDER DIAMETERS FOR AIR COMPRESSORS—III.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10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
80 pounds Gage Pressure. Ratio of cyl. areas = 2.75
100 pounds Gage Pressure. Ratio of cyl. areas = 3.03
125 pounds Gage Pressure. Ratio of cyl. areas = 3.35
150 pounds Gage Pressure. Ratio of cyl. areas = 3.64
200 pounds Gage Pressure. Ratio of cyl. areas = 4.17
250 pounds Gage Pressure. Ratio of cyl. areas = 4.63
300 pounds Gage Pressure. Ratio of cyl. areas = 5.06

Compound Air Cylinders for 5,000 feet Altitude Compression.
Atmospheric pressure 12.2 pounds per square inch.

be calculated as 6119 calories per kilogram of fixed carbon consumed. If, by using dried blast, 18 per cent. less carbon is thus consumed (giving, however, just as much available heat in the tuyere region and 61.75 kg. is burned to CO, producing 144.1 kg. of CO, 73.15 kg. of this will be likewise converted into CO^2 by the 41.8 kg. of oxygen from reduction (producing just the same amount of heat in the upper part of the furnace) and the total heat of oxydation of the carbon to this proportion of CO and CO^2 can be calculated as 6928 calories. The carbon burned in the furnace is therefore utilized with some 13 per cent. greater thermal efficiency when using the smaller quantity in the tuyere region required by the dried blast.

Similar calculations could be made as to the smaller velocity with which the smaller amount of cooler gas passes through the upper part of the furnace, and the consequent better utilization of its reducing power and of its sensible heat in heating the descending charges. Analogous calculations could be made showing quantitatively the smaller radiatrix and conductrix loss per unit of product, when using dried blast. The data for such calculations are, however, not as abundant or as trustworthy as those already used. A longer experience with dried blast in practice will enable these data to be also used quantitatively, with convincing results.

A PNEUMATIC SPOTTER

The following we have strained out of a newspaper reporter's story:

There was many a stop, many a shudder and many a wondering look yesterday among the passengers who passed the ticket choppers of the Hudson Tunnel entrance in Hoboken. No one knew he was being experimented on and the several passengers who did not shudder thought some one had touched them on the arm. The passengers were being counted by compressed air, and the counter ghost was keeping tabs on the ticket chopper, who wore a worried look.

Counting by compressed air is achieved through the continued flow of air from a pipe rising from the ground about three feet. This stream of air flows horizontally against two diaphragms. When nobody passes and the air is flowing, the diaphragms do not touch, but as soon as there is an interruption to the stream the two delicate diaphragms meet and through an electrical contrivance the device registers the interruption. The pipe is about an eighth of an inch in diameter, and the temperature of the air flowing from it is about 70 degrees. Not only can the figures be recorded in the ticket office, but an arrangement can be made whereby the central office gets the approximate count of all passengers at the time they pass the ticket chopper.

In the test it was noticed that while the passengers were entering the station slowly the counter worked accurately. But when two persons passed close together only one fare was marked up by the counter, as there was only one interruption of the air current. When that happened the ticket chopper was seen to smile, but sadness was on the ticket chopper's face when a small boy stood before the stream of compressed air, and, clapping his hand against it, managed to register about a dozen fares before the ticket chopper could stop him.

One old woman who thought the ticket chopper had called her passed by the stream of air in going back, and then, when she found she was mistaken, passed on again. She registered three fares and would have struck up another if the conductor had not waved her back.

Then came another accident that made the ticket chopper sad. A youth passed the pipe without depositing his ticket. The chopper called to him to put it in the box.

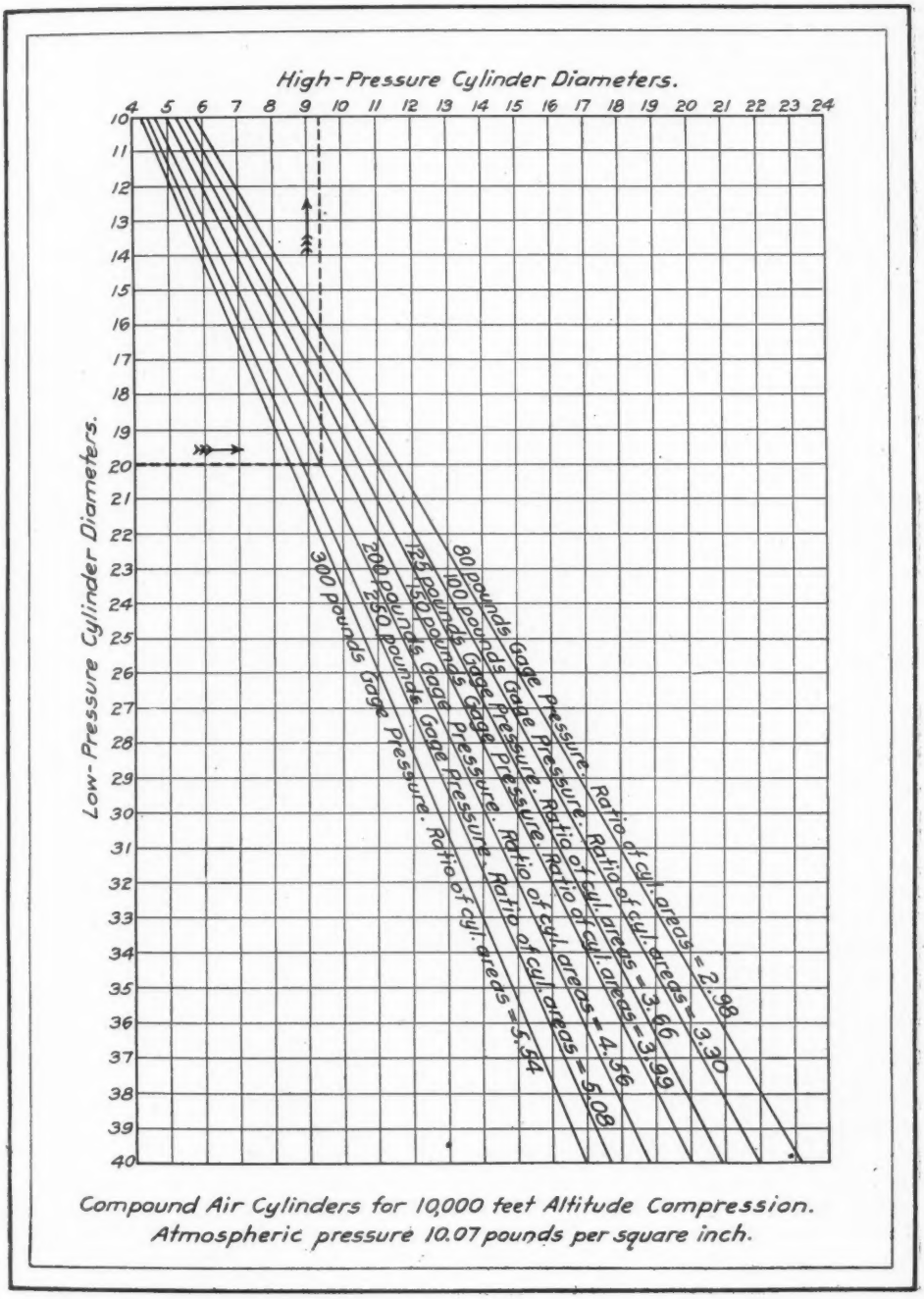
"Don't come back!" yelled the chopper. "Don't come back. Stay where you are." And, forgetting his body also interrupted the stream of air, the chopper left his post to get the ticket. Then he saw the diaphragms meet, and to avoid registering up another fare he had to crawl under the pipe.

"What is that infernal draught?" one passenger asked.

"That's a counter," said the chopper, banging the handle up and down in the glass box and assuming an expression of contempt for a person who seemed ignorant of the compressed air counter's habits. The passenger passed the device, then came back again and looked at it, and was astonished when the man at the box asked him to pay two more fares.

"You've registered three times instead of once, and you've had all the fun out of it,"

HIGH-PRESSURE CYLINDER DIAMETERS FOR AIR COMPRESSORS—IV.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150 pounds Gage Pressure. Ratio of cyl. areas = 3.99
200 pounds Gage Pressure. Ratio of cyl. areas = 4.56
250 pounds Gage Pressure. Ratio of cyl. areas = 5.08
300 pounds Gage Pressure. Ratio of cyl. areas = 5.54

Compound Air Cylinders for 10,000 feet Altitude Compression.
Atmospheric pressure 10.07 pounds per square inch.

snapped the chopper. The passenger came back again to find out what the tunnel employe was angry about, and finally he was made to understand that every time he passed the device it meant a nickel out of the ticket chopper's pocket, except for the first fare.

"Well," said the curious one, offering the man at the box a half dollar, "how long can I look at it for that?'

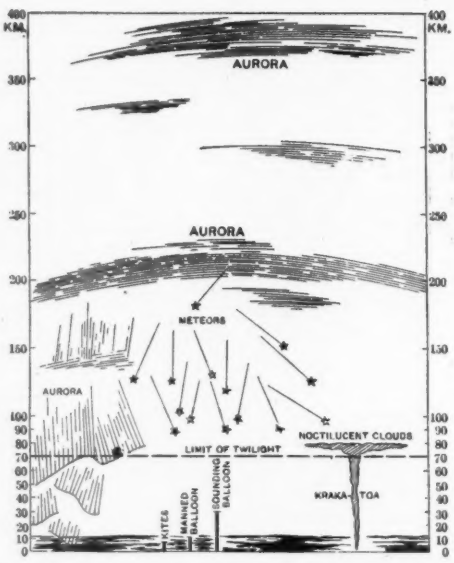
"As long as you like, without paying, but don't pass," was the answer. "See that those diaphragms don't touch, for every time they meet that means a nickel that has to be accounted for."

VERTICAL EXTENT OF THE ATMOSPHERE

The accompanying diagram, reproduced from a paper by Dr. Alfred Wegener in a recent number of Das Wetter, illustrates the field of aerological investigation; i. e., the whole extent of the atmosphere in a vertical direction.

The partly shaded strip at the base of the diagram represents the portion of the atmosphere called the troposphere, or region of convection, extending from the earth's surface up to the level of the cirrus clouds. In middle latitudes its upper limit is at about 10 kilometers (6.21 miles). Within this relatively shallow stratum lies three-fourths of the total mass of the atmosphere, and herein are confined the great convectional disturbances known as cyclones and anticyclones. This region has been explored up to an altitude of 7 kilometers (4.35 miles) with meteorological apparatus attached to kites, and it was penetrated quite to its upper limit by the balloonists Berson and Süring in their ascent of July 31st, 1901, when they attained an altitude of 10,800 meters (35,324 feet).

Above the troposphere lies the stratosphere, or isothermal layer, extending upward to an unknown height. This region is inaccessible to kites and manned balloons, but has been penetrated to an altitude of 29 kilometers (18.02 miles) by sounding balloons, carrying meteorographs. Here the air is exceedingly dry and cold, and is in a state of vertical isothermy; i. e., there is no decrease of temperature with increasing altitude such as we observe in the lower atmosphere. There is probably little interchange of air by convection, and there are no violent disturbances



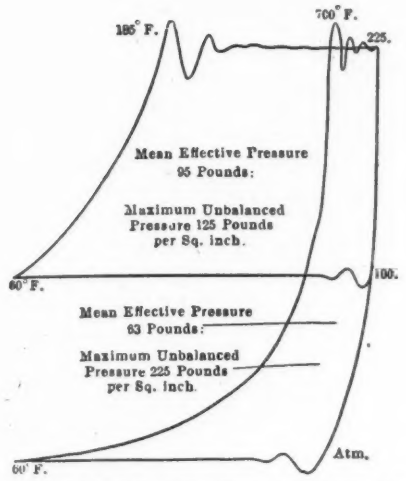
THE EXTENT OF THE ATMOSPHERE IN A VERTICAL DIRECTION. HEIGHTS IN KILOMETERS.

such as constitute the storms of lower levels.

Above the heights reached by sounding balloons we have no direct instrumental record of the conditions of the atmosphere, and must resort to other means of investigation. From the duration of twilight we infer that at an altitude of about 70 kilometers (43.5 miles) the air becomes so tenuous that it can no longer reflect light to the earth. A little higher, viz., at about 80 kilometers (49.7 miles), our topography of the atmosphere must take account of the "noctilucent clouds" observed for some years following the eruption of Krakatoa, and likely to be seen again after any great volcanic eruption. They consisted of dust projected to this great height—far above the highest level of true clouds—by the volcano, and shining with reflected sunlight.

Still higher the presence of an atmosphere is indicated by the trails of meteors, which appear to be especially numerous between 100 and 150 kilometers (62.14 and 93.21 miles) above the earth.

The highest of all atmospheric phenomena of which we have any knowledge are auroral discharges, which, however, also occur at lower levels, down to the earth's surface. These appear to have two levels of maximum frequency, viz., at about 200 kilometers (124.3 miles), and at 60 to 70 kilometers (37.3 to 43.5 miles) above the earth's surface.



A PARADOX OF TWO-STAGE AIR COMPRESSION

The accompanying cut, from the *American Machinist* is used in that publication by Mr. S. B. Redfield in explanation of a rather paradoxical situation which occurs in two stage air compression. In a previous issue of the "Machinist" a correspondent called attention to the use of an air brake pump for compressing air in a single compression to 225 lbs. gage pressure, and then of supplying the pump with air already compressed to 100 lbs. to assist" it, with the result that the pump when thus assisted required considerably more power to drive it than before.

This would mean, Mr. Redfield continues, that if the pump were of the fly-wheel type it would run with less effort if drawing from the atmosphere than if receiving air at an initial pressure of 100 pounds. From this it must not be inferred that it takes more work to fill the second tank with air at 225 pounds pressure when the pump intake is supplied with an initial pressure of 100 pounds, than it would take if drawing from atmosphere; it simply means that the *average* piston effort when drawing from atmosphere would be much less than when drawing from 100 pounds, although the pump would have to work a longer time to fill the second tank when drawing from atmosphere than it would if drawing from the higher initial pressure. The reason for this is that when receiving air at 100 pounds pressure, the air handled in the cylinder is much denser and therefore the mean effective pressure or the work per stroke is much greater, though fewer strokes will have to be taken. The appearance of the indicator diagrams in the two cases is seen in the line cut, and it will be noted how much more nearly rectangular is the diagram when pumping from the high initial pressure than when pumping from atmosphere.

While the *mean* effort would be much less when drawing from atmosphere, it is a fact that the *maximum* effort at the end of the stroke would be almost double, and it is at this point that the pump would stall in the absence of a flywheel, unless assisted by the high-pressure inlet, as actually used. The employment of a flywheel on the pump would carry it over these high peak points at the end of each stroke, and the actual work performed per stroke would be less when drawing from atmosphere.

To get down to figures; the mean effective pressure developed when drawing from an initial pressure of 100 pounds and discharging at 225 pounds, would be about 95 pounds per square inch, while if drawing from atmosphere and discharging at 225 pounds, in a single stage, the mean effective pressure developed would be only 63 pounds. With a 7-inch piston, the mean total piston effort with the high intake pressure would be about 3650 pounds, and with atmospheric intake this mean total load would be only 2425 pounds. At the end of the stroke, however, when drawing from 100 pounds, there would be a maximum unbalanced pressure of only 125 pounds per square inch, or a total maximum load of 4813 pounds, while if pumping from atmosphere, this maximum unbalanced pressure would, of course, be 225 pounds per inch, or total maximum load of 8663 pounds.

While this is a curious state of affairs, it is clear to see that the employment of the auxiliary tank, giving the high inlet pressure, is an advantage, not only making it possible to use a pump without a flywheel, such as is already handy in a railroad shop, but considerable time and total work is saved by this means, in the final filling of the second tank, although this initial work is performed of course, by some other air compressor in the shop.

Aside from the question of work done by the pump, there is the even more important matter of temperature, especially with an unjacketed compressing cylinder. With 100

pounds inlet and 225 pounds discharge, the number of compressions is 2.09 and the final air cylinder temperature only about 185 degrees Fahrenheit, while if drawing from atmosphere there will be 16.3 compressions, giving a final air cylinder temperature of over 700 degrees. At such a temperature lubrication becomes a serious problem, as explosive gases often are formed by the action of the located air upon the oil.

used only for supplying air to the working chambers of the tunnel shields under the river. In this way the air capacity could be increased three or four times.

The percussion drills used were of the Ingersoll-Sergeant type, Nos. 3½, A-86, C-24 and F-24.

The air was compressed to 100 pounds per square inch in the power-house and was delivered at about 80 pounds per square inch

Type.	Date.	Drilling and Blasting. Total feet drilled.			No. of drill shifts. (10-hour.)			Feet drilled per man per hour.			Quantity of excavation, in cubic yards.		Cost of labor only. Drilling and sharpening. Total				Powder Used. Total quantity.	Cost per cubic yard at 11 cents per pound.	
														For linear foot.	Per cubic yard.				
	1907	Heading.	Bench.	Total.	Heading.	Bench.	Total.	Heading.	Bench.	Total.	Actual.*	Paid for.†			Actual.	Paid for.	Pounds.	Actual.	Paid for.
													$	$	$	$		$	$
Ke.	May	2 971	5 576	8 549	96	204	300	3.061	2.734	2.861	1 726	1 664	2 231	0.27	1.34	1.40	1 595	0.10	0.10
	June	2 098	6 194	8 287	85	223	308	2.462	2.777	2.691	809	698	2 440	0.29	3.01	3.49	1 990	0.27	0.31
	July	.....	7 627	7 627	.....	266	266	.....	2.845	2.845	1 022	960	2 021	0.26	1.98	2.11	995	0.10	0.11
	Aug.	.....	2 258	2 258	.....	95	95	.....	2.668	2.668	743	716	640	0.25	0.86	0.89	430	0.08	0.07
	Sept.	.....	2 133	2 133	.....	79	79	.....	2.700	2.700	238	238	533	0.25	2.24	2.24	280	0.13	0.13
	Total	5 064	24 084	29 148	183	869	1 052	2.767	2.77	2.77	4 548	4 276	7 975	0.27	1.75	1.87	5 231	0.13	0.13
Kt.	May	6 976	.....	6 976	216	.....	216	3.229	.....	3.229	614	527	1 604	0.23	2.61	3.04	1 230	0.22	0.26
	June	4 089	.....	4 089	135	.....	135	3.029	.....	3.029	327	259	1 234	0.30	3.45	4.76	1 035	0.32	0.44
	July	.....	3 723	3 723	.....	140	140	.....	2.666	2.666	530	404	1 064	0.29	2.01	2.63	550	0.11	0.15
	Aug.	.....	6 715	6 715	.....	249	249	.....	2.700	2.700	950	950	1 901	0.28	2.05	2.13	905	0.10	0.11
	Estim.	.....	14 742	14 742	.....	546	546	.....	2.700	2.700	3 254	2 909	4 570	0.31	1.40	1.57	2 470	0.08	0.09
	Total	11 065	25 180	36 245	351	935	1 286	3.152	2.694	2.819	5 680	4 998	10 398	0.29	1.83	2.08	6 191	0.12	0.14
Ko.	May	.....	1 617	1 617	.....	55	55	.....	2.921	2.921	250	188	471	0.29	1.88	2.50	376	0.17	0.22
	June	.....	2 948	2 948	.....	107	107	.....	2.755	2.755	496	347	883	0.29	1.78	2.54	337	0.08	0.11
	July	.....	3 734	3 734	.....	131	131	.....	2.850	2.850	626	606	1 008	0.27	1.60	1.85	609	0.11	0.11
	Aug.	.....	8 260	8 260	.....	290	290	.....	2.848	2.848	718	709	2 161	0.26	3.00	3.04	919	0.14	0.14
	Estim.	.....	4 787	4 787	.....	285	285	.....	1.680	1.680	805	535	2 397	0.50	3.96	4.48	762	0.14	0.16
	Total	.....	21 346	21 346	.....	868	868	.....	2.460	2.460	2 695	2 385	6 915	0.32	2.57	2.90	3 022	0.12	0.14
Grand Total		16 129	70 680	86 749	534	2 672	3 206	3.020	2.710	2.710	12 923	11 649	25 288	0.29	1.96	2.17	14 444	0.12	0.14

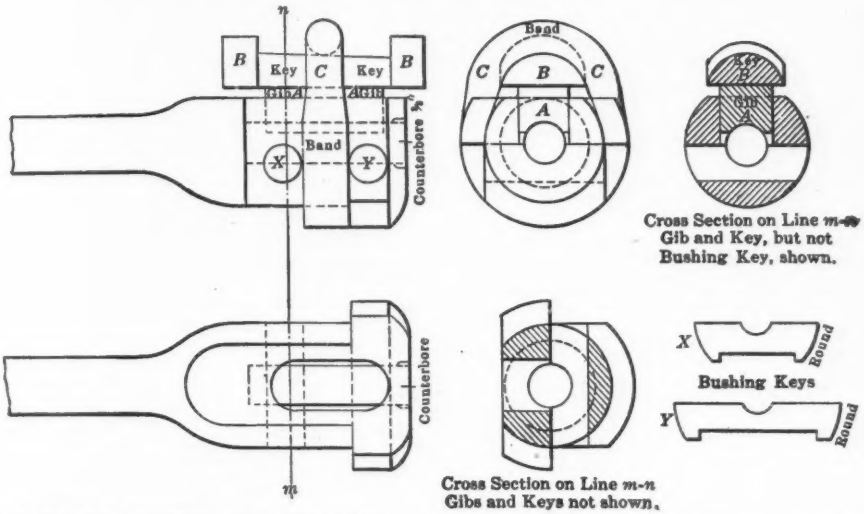
DRILLING AND BLASTING COSTS OF THE PENNSYLVANIA NORTH RIVER TUNNELS

Complete itemized costs of drilling and blasting in the North River tunnels of the Pennsylvania Railroad at New York are given in a paper by Messrs. B. H. M. Hewett and W. L. Brown, describing that work in detail, recently published in the proceedings of the American Society of Civil Engineers, the table above being from that paper.

At each plant air was furnished by one high-pressure compressor. This machine had duplex 14¼x36-inch Ingersoll-Rand air cylinders, and was connected to a cross-compound, Corliss-Bass steam engine with 14-inch and 26-inch cylinders. The air cylinder was water jacketed with circulating salt water. This compressor could supply air for about nine drills, running unassisted. But on occasion when there was an unusual demand on account of heavy drilling work, an additional supply was obtained from three low-pressure Ingersoll-Rand machines in each plant, ordinarily at the drills. A 3-inch air line was used. The drill steel was 1⅛ to 1⅜-inch octagonal. The holes were about 3¼ inch in diameter at starting and 2⅝ inches at full depth of 10 feet. The powder used on the New York side was 40 per cent. DuPont Forcite, the near presence of heavy buildings and lack of much rock cover necessitating light charges and many holes spaced close together.

To compensate the contractor for the inevitable excavation done outside the neat lines of the masonry lining, the excavation was paid for to the standard section line, which was 12-inches outside the neat lines on top and sides and 6 inches outside at the bottom of the cross section.

On the Weehawken side, in the rock blasting, 60 per cent. Forcite was used. The average length of hole drilled per cubic yard of excavation was 2.9 feet as against 7.7 feet at Manhattan; and the amount of powder used was 1.96 pound per cubic yard as against 1.24 pounds at Manhattan.



BOLTLESS CHUCK FOR PISTON DRILLS

In the North Star mines, at Grass Valley, Cal., a special type of chuck designed by Messrs. Paynter and Bastian, employees of the company, is used on the piston-machine drills. The peculiarity of the chuck is that it includes no bolts, and hence does not require the use of a wrench for tightening the hold upon the drill shank. The accompanying working drawing shows the details of the chuck and clamping arrangement.

The chuck is drilled as usual to receive the shank of the drill steel. A slot, above and parallel to the shank of the steel, is cut in the chuck to receive a gib *A* that bears against the shank of the drill. Below the drill socket and perpendicular to the axis of the chuck two holes are cut to receive bushing keys *X* and *Y*, that bear against either end of the lower part of the drill shank and take up wear from the chuck. A strap or band *C* fits around the chuck and over a tapered key *B* that bears on the gib *A*. The key *B* is tapered away from the end of the chuck so that when every impact of the drill against rock drives it further under the strap *C*, the gib is forced more tightly against the drill shank. There is, hence, no tendency of the drill to become loose in the chuck. On the other hand, it is held more securely at each stroke. The key *B* is made with a heavy head at either end.

To fasten the drill in the chuck the key is driven tight by a blow upon the head at the larger end. A blow on the other end of the key serves to loosen it and allows the drill to be removed. This type of chuck has been used for several years in the North Star mines and has proved entirely satisfactory.—*Eng. and Min. Journal.*

SPECIFICATIONS FOR AIR HOSE*

When the question of the purchase of some 50,000 feet of air hose for use at the Mare Island Navy Yard was taken up several years ago, it was found that up to that time no definite specifications were in use under which this hose could be purchased. Applications made to the purchasing departments at other navy yards developed the fact that each yard purchased its hose under special specifications gotten out at that particular plant, and that hose was being used at one place costing 85c. a foot, while hose of a different nature used for exactly similar purposes was apparently answering all requirements at a purchase price of 35c. a foot. It was believed to be a highly opportune time to attempt the preparation of a uniform set of specifications covering all pneumatic hose for use at the various navy yards.

KINKING AND PRESSURE TEST.

After quite a little investigation it was decided to adopt a combination kinking and

*Condensed from an article in the *American Machinist* by R. D. Gatewood, Assistant Naval Constructor, United States Navy.

pressure test, and for this purpose a special machine was prepared. [An apparatus practically identical was illustrated and described in COMPRESSED AIR MAGAZINE, May, 1909, Vol. XIV, page 5279.]

The actual test was conducted as follows:

A test piece 20 inches in length was fastened securely at each end by means of a number of elbow-nipple connections, the nipples being slightly corrugated. One inch of the nipple is allowed to enter the end of the hose, which is then secured by two bands of No. 7 B. & S. gage soft copper wire, hove up by a hand vise, so that when the machine is running the give of each sample is as slight as possible, and, as nearly as may be, equal to that of the other samples on the machine. It was found highly essential that all nipples be of the same length and that their ends be carefully rounded off in order to avoid the friction of the end of the nipple on the inner rubber tube. This point was found to be of the greatest importance and in any test of a similar nature too much care cannot be taken to prevent this friction, for it is upon the strength of this inner rubber tube that the ultimate strength of the hose depends. The length of 20 inches was decided upon after considerable experimentation.

The nipple connection above mentioned is made up on a 45-degree elbow, the stationary end being turned up and the moving end turned down. The distance between the ends of the couplings or nipples when level is about seven inches. One end remains stationary and the other end moves up and down through a distance of about 14 inches, by means of a crosshead working in guides, so that the hose is kinked about 80 times a minute. The kinking occurs in two places in the length, about four inches from each end, the angle through which the hose is bent being from 60 to 70 degrees. During the entire time the hose is being kinked, a pressure of 90 pounds per square inch is maintained on the hose, this pressure being the pressure at which the hose is required to work in service. In comparatively few instances in the kinking test was it found that the sample actually burst. The rubber covering of the hose frequently gave way, but this was not considered to be a material defect. The samples were carefully watched, particularly at the end of the specified kinking test, and if a slight leak was discovered the machine was stopped. If there was not found to be a steady flow of air, the machine was again started. If, however, there was a steady flow of air escaping, it was considered as denoting the end of the kinking time for that particular sample.

This specified kinking time was, of couse, the hardest part of the specifications to determine upon, and after tests upon 20 different samples of hose submitted by different companies, the following requirements were decided upon:

Size of Hose.	Length of Test, in Hours.
3-8 inch	45
7-16 inch	40
5-8 inch	30
3-4 inch	25
1 1-4 inch	3

In addition to the above kinking test, all hose was required to stand a hydrostatic pressure of 600 pounds, though under ordinary conditions of service the hose would only be required to stand about 90 pounds.

In addition to the above requirements, the specifications were purposely made sufficiently loose to cover the ordinary commercial grades of hose in the matter of cotton ply. This was done in order not to limit the purchase of suitable hose to hose of special manufacture, such as is now used on vessels of the navy for fire purposes, the idea, of course, being to reduce the cost as much as possible and still obtain a serviceable article.

The kinking test on the large size (1 1-4 inches) was considered to be more or less comparative only. By means of this test on the large size hose, it is possible to pick out *some samples* that are *better* than others, but it is impossible to pick out the *best*. The results of the 600-pound water test were considered of more value as a measure of the quality of the large size hose than were those of the kinking test.

STANDARD SPECIFICATIONS.

From the above test the following specifications were gotten up by the bureau of construction and repair, and are now in use for the purchase of all pneumatic hose used at navy yards under that bureau:

"1. The hose to be made up of an inner rubber tube, three or more canvas or braided

layers, and an outer rubber cover; to be of the internal diameter required for.

"2. The tube and cover shall be free from pitting or other irregularities; the tube shall not be less than 1-16 of an inch, and the cover not less than 1-32 of an inch in thickness. The hose to be of the best quality rubber, duck and friction, and to be capable of standing a hydrostatic pressure of 600 pounds.

"3. At the time of submitting bid, and prior to the opening of bids, each bidder shall submit to the general storekeeper at the yard from which the hose is purchased, a sample of each size of the hose on which he is bidding. These samples will be submitted to the mechanical kinking test, and the award of contract will be based on the result, the bidder whose sample shows the best result as compared with the price bid will be given preference, the Government reserving the right to reject any or all bids. No sample shall be considered satisfactory that does not stand the test for the following length of time without leakage at 90 pounds air pressure:

3-8 inch	45	hours
7-16 inch	40	hours
5-8 inch	30	hours
3-4 inch	25	hours
1 1-4 inch	3	hours

"4. A sample from each delivery will be tested in a similar manner to demonstrate whether it is equal to the sample submitted with the bid.

"5. The kinking test is conducted as follows: The test piece, 20 inches in length, is fastened to couplings made up on 45-degrees elbows, the stationary end turned up and the moving end turned down. The ends of the couplings when level are seven inches apart. The moving end travels vertically through a distance of 14 inches, and the speed is such that the hose is kinked about 80 times a minute, the kinking occurring in two places about four inches from each end. During this test an air pressure of about 90 pounds per square inch is maintained in the hose."

The adoption of the above specifications has resulted in the purchase at a very reasonable price of hose which is amply strong to withstand all service pressures, and at the same time of such construction and pliability as to produce good results in use. The test of comparatively short duration and awards can be made almost immediately after receipt of bids, as the test can be conducted prior to the date on which the bids are to be opened, and it is only necessary to compare the results of the test with the bids in order to recommend award. While it is appreciated that the results do not indicate definitely the manner in which the hose will stand up in service, it is found by experience that hose which stands up well in the kinking test gives good satisfaction in service.

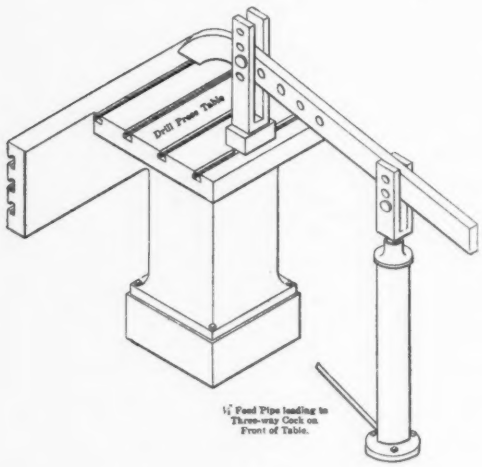
OIL RESOURCES OF CALIFORNIA

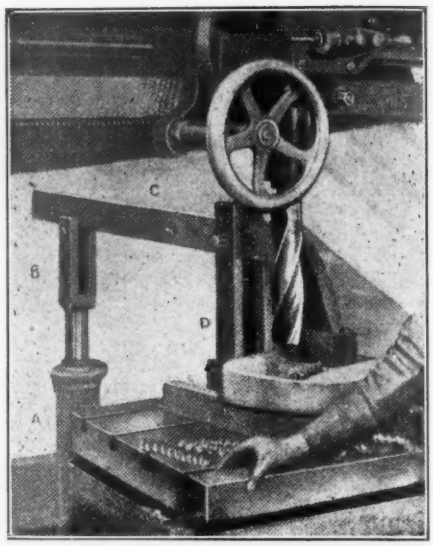
Few of us have even begun to realize the wonderful development of the oil industry of California in the past ten years or the enormity of the present and prospective supply. This is strikingly set forth in a recent address by Mr. DeKalb before the California Board at Nevada City, Cal. He calls attention to the very apparent fact that California has entered the age of oil, and that from very modest beginnings it has risen to pre-eminence. Ten years ago it produced 4,000,000 bbls. yearly, now 75,000,000 bbls., and it is estimated that it will keep up its yield for at least 50 years. There are 255 producing wells in the Midway field alone; 10 are veritable geysers of oil. The Lakeview has been spouting 48,000 bbls. daily for three months, outstripping Baku, in Russia, and holding the world's record; 75 square miles of territory has been proved. The oil is found in deposits overlying the ancient eroded surface. Gushers are pools in the deepest scored early land area, as if a canon had been filled with sand and the oil had then been accumulated in the interstices. Gushers may be due to gravity under pressure from a high head, or to expansion of compressed gases accumulated above the oil in a pool. As usual in other fields, the anticlines hold the oil, the synclines the water. The market for oil is constantly widening. A few years ago coal was a competitor of oil on the Pacific coast, today crude petroleum has monopolized the field as a fuel, except for domestic heating.

The facilities for distribution are excellent and will give some idea of the vastness of the enterprises. The Producers Transportation Co. operates an eight-inch pipe line 210 miles to Port San Luis, serving the Sunset, Midway, Kern and Coalinga fields, transmitting 20,000 bbls. daily. The Associated Oil Co.,

serving the same fields, operates an eight-inch pipe line 350 miles to Port Costa, in San Francisco bay, and a six-inch line 10 miles to Monterey. The Standard Oil, draining from the McKittrick, Kern, Midway and Sunset fields, transmits 35,000 bbls. per day to Point Richmond, 345 miles through an 8-inch main. There are 21 pumping stations in this line. When we consider that the cost of these pipe lines, with all accessories, averaging about $10,000 per mile, one gets some idea of the expense involved, warranted by confidence in the field. A pipe line is even projected to Arizona, to serve the six railroads in that territory, as well as the copper district of Globe, Miami and Douglas, and Canada copper district in the state of Sonora, Mexico.

The consumption of oil on the Southern Pacific system alone amounts to 9,000,000 bbls. per year. California oil goes to British Columbia, Alaska, and the Orient, to Panama and to every Pacific point as far as the Straits of Magellan. There are 6,692 producing wells in the state. As regards investments and cost: It costs $6,000 per acre to drill and equip wells, giving a total investment of at least $100,000,000. Pipe lines alone represent $10,000,000, refineries, tanks, cars, ships, etc., $50,000,000. Land drained by wells, average value, $2,000 per acre, or $60,000,000 total. This gives a grand total of $210,000,000. The output of 79,000,000 bbls. yearly at 40 cents per barrel, is worth $31,600,000; half is available for dividends, hence the oil industry earns 7½ per cent. on invested capital.

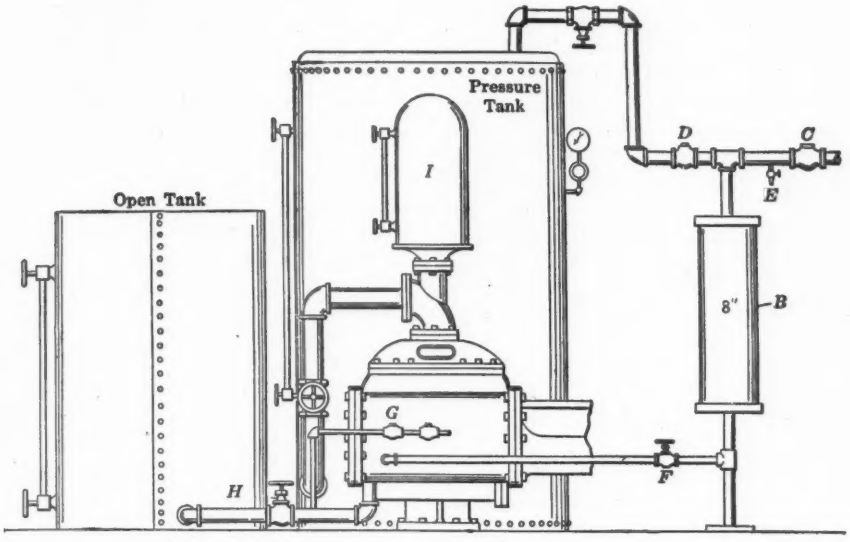




PNEUMAUIC CLAMP OR WORK HOLDER

The half tone and the isometric sketch on this page, reproduced from the *American Machinist,* show a handy pneumatic clamp which is provided for every machine having need of it in the Beech Grove shops of the Big Four Railroad. Practically no explanation is required. The most frequent use of the clamp is upon the radial drill, as seen in Fig. 1. It consists primarily of the pneumatic cylinder *A*, which has a pipe from the air line running into its base. When air is admitted it forces the plunger *B* up against the clamping lever *C*. This clamping lever fulcrums in the yoke *D*, which is made to be easily fastened to any part of the table by T-headed bolts so that it can be applied in almost any position. Any shop having an air supply, and what railroad shop has not? will find the clamp a great time saver, as it entirely does away with the use of straps and bolts in any work of its kind, doing both the clamping and the releasing instantly.

"Aggie is fifty, and so thin that when she wears a tailor-made suit she has to build out with pneumatics. You remember, at the Woman's Suffrage Convention, how Mrs. Bailey pinned a badge to Aggie, and how there was a slow hissing immediately, and Aggie caved in before our very eyes."—*Saturday Evening Post.*



PIPING BY WHICH PUMP IS MADE TO SUPPLY AIR TO SYSTEM

PUMPING AIR WITH A WATER PUMP

The accompanying sketch shows an ingenious method of forcing air into the pressure tank of an hydraulic-elevator system. The cost of installing this device is small as compared with that of an air compressor, and it gives very satisfactory results.

The method of operation is as follows: First, valve *F* is opened while the pump is in operation and when *B* becomes full petcock *E* will show water. Just before air begins to be sucked in, on the return stroke of the pump, *E* is closed; this draws air in through check valve *C*. On the next stroke of the pump, the pressure closes *C* and forces valve *D* open, and the air passes over into the pressure tank. By this arrangement, no air gets into the body of the pump, the reservoir *B* being filled with water and pipe *F* is not sufficient to drain it at one stroke of the pump.

The pipe and check valve at *G* is for charging the air chamber *I* which loses air through the gage valves. By closing valve *H*, air is drawn in through *G* and soon appears in the top of the glass on the air chamber.—*Power and the Engineer.*

Cincinnati factories are now using 300,000,000 cubic feet of natural gas per month. The Government building is the latest large consumer.

THE COMPRESSED AIR SERVICE ON THE PANAMA CANAL

The following is a recent summary by *The Engineer,* London, of the compressed air installations on the Panama Canal work. It is premised that all the drills are operated by compressed air. The system supplying air to the drills in the Central Division and at the Pedro Miquel and Miraflores locks, for the large shops at Empire, and the field repair shops at various points, extends a distance of about 13 miles. The main line is made up of 38,800 ft. of 10-in., 14,600 ft. of 8-in., 10,000 ft. of 7-in., and 4,000 ft. of 6-in pipe, and from these mains air is conveyed to different parts of the cutting by "leads" aggregating over 34 miles, composed of 2-in. to 8-in. pipe. There are three compressor plants, situated at Rio Grande, Empire, and Las Cascades, each equipped with two Ingersoll-Rand and two Laidlaw-Dunn-Gordon compressors, with an aggregate maximum output of 1,800,000 cubic feet of free air per hour. Since the installation of oil-burning apparatus the fixed daily charges in connection with these plants, now being added to by the installation of Rand compressors at Rio Grande and Empire, have been reduced by over £25. Other extensive air-compressing plants are running at Balboa, Porto Bello, and at the Gorgona and Cristobal shops.

RAIN AT PANAMA

The rainiest July of record on the Isthmus was that which has just closed. There were showers on each of the 31 days, and some of the most violent of these occurred during hours when work was in progress on every section of the Canal and railroad. A popular deduction from past rainy seasons is that there is likely to be a heavy shower between 12 and 2 o'clock each day, and the meteorological records on the Isthmus sustain this belief, to the extent of showing that the noontime rains are very frequent and often heavy, as much as two inches of rain falling in one hour.

At Gatun during the hardest part of such a storm, one who looks out across the valley from the division office can see but dimly the lock monoliths and the cableway towers near-by, while the workers on the Dam beyond the locks are quite obscured from view. Gradually the more intense rain gives place to a gentler downfall, and it often happens that within half an hour after the blinding shower the sky is blue and the sun is shining. To one who watches from shelter it is a fair assumption that during the most violent part of the rain the men have found some protection and the work has been temporarily suspended. He can see that this is not true during the drenching but gentler parts of the storm; and if he were out on the Dam, at the spillway, or in the lock site, he would know that the work seldom ceases during any part of the rain.

The men at work on the toes of the Dam cannot shift track so rapidly in wet as in dry weather, and there is an added inconvenience in the dumping of rock and earth from the spoil trains but they can do some work and, while they can, they do it. In a locality like Gatun, where rain is the rule and fair weather the exception, this persistence through the heaviest showers makes a great difference in the amount of spoil that can be unloaded on the toes of the Dam, and it explains in a measure why that work is keeping pace with that on the Locks. Showers make no difference to the force on the hydraulic fill, because the dredges and relay pumps are under cover, and at the spillway it is not allowed to interfere; the men put on their waterproof coats and keep at work.

Half of the concrete work at the Locks is also done under cover; that is, the materials are sent to the mixers, mixed, and delivered over the lock site by men protected from the rain. They set the pace for the outside workers. Concrete is spaded into place as long as the cableway operator can see the signals of the man whose flag directs the movement of the buckets, and all the rest of the work moves in consonance with this.

One of the wettest places in Culebra Cut is the pit in which a steam shovel works, because the pit is filled knee-deep with water, and there is no protection overhead. The pitmen are laborers, usually negroes, and they pay as little attention to the rains as the Spanish track laborers, and the white Americans who direct the work. A statuesque picture of indifference to weather is the conductor of a spoil train running out of Culebra Cut. The engineer and firemen are in the locomotive cab and dry, but the conductor is entirely exposed during the heaviest storms, as he sits on the high side of the rear flat car of a train carrying spoil to the dumps or running back to the Cut where some steam shovel is waiting for more cars. It is an unusual storm that forces a steam shovel to suspend, unless the drainage of the pit is stopped and the water puts out the fire. The track gangs keep at work in the Cut and on the dumps where the mud is literally up to their knees, because disposing of the spoil, not excavating it, is still the determining factor in the digging of Culebra Cut.—*The Canal Record.*

FIREDAMP AND BAROMETRIC PRESSURES

An elaborate memoir on this subject has recently been prepared by M. Léon Morin, of Liévin ("L'Influence des Variations de la Pression Atmosphérique sur les Dégagements de Grisou," *Bulletin* de la Société de l'Industrie Minérale, July, 1910). At the outset he gives a synopsis of the views published in this country and elsewhere, and finds that most engineers of experience are in agreement as to the influence of atmospheric pressure on the emanations of firedamp from old workings, but that opinions differ as to the influence of these variations on emanations at the working face. For some time observations have been made at Liévin, and these establish the two main facts that heavy depressions of the barometer are followed by the appearance of traces of firedamp in certain feebly-

ventilated roadways or in roads terminating in a *cul-de-sac;* and a rise in the proportion of firedamp in several return airways. M. Morin arrives at the following conclusions:—

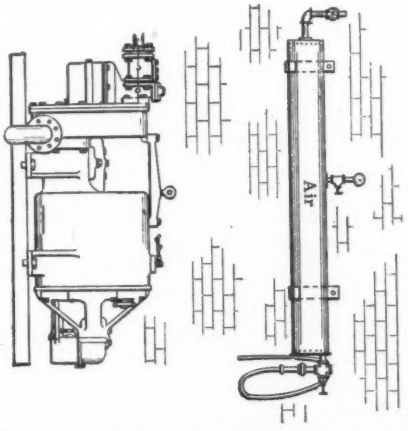
1. That variations of atmospheric pressure, even when very slight, produce variations in the emanation of firedamp; all things being equal, when the pressure is constant, emanation of firedamp is equally constant.

2. When the atmospheric pressure increases, the emanation decreases, and, inversely, if the pressure decreases, the emanation increases.

3. A maximum of atmospheric pressure correponds with a minimum of firedamp content, and *vice versâ.*

4. The variations can be very considerable, a fall in the pressure from 770 mm. to 740 mm. giving a variation in content of 50 per cent.

5. There is no strict relationship between the variation in firedamp content and the variation of pressure.



A COMPRESSED AIR DUST BLOWING OUTFIT

The accompanying illustration shows the method used by an engineer in Richmond, Va., for obtaining an air supply for blowing out dust from the generator end of a small Curtis turbine set.

In his plant was a small belt-driven air compressor, which furnished compressed air for removing shavings from the wood-working machinery in the factory to the boiler furnaces. In this case a small 30-gallon water tank was obtained which was capable of withstanding an air pressure of 70 pounds to the square inch. This air tank was secured to the wall of the engine room directly over the turbine unit, by means of two hangers made of ⅛-inch strap iron, curved so as to form a cradle for the tank, as shown. At one end of the tank was fitted a nipple to which was screwed the air pipe running to the compressor, this pipe being fitted with a valve to permit shutting off the tank from the air-pump line. On the other end of the tank, at the top, was fitted a long nipple to which an angle valve was screwed. To this valve was screwed another long nipple to which a hose coupling was attached, the hose being long enough to reach to all parts of the turbine as well as to the switchboard. The tank was inexpensive, neat in appearance, being painted with aluminum, and efficient in operation.—*Power and the Engineer.*

TUNNEL PRESSURE EXPERIENCES

In the account by Mr. C. H Hollingsworth, superintendent for the contractors, the Buffalo Dredging Company, in the construction of the Buffalo Waterworks Tunnel, the following has to do with the experiences of the men working under air pressure. But few accidents or serious injuries occurred in the three and one-half years of working. One man was killed by an elevator and another had a leg crushed by an electric locomotive. The chief and constant trouble was from bends or caisson disease.

This was usually confined to new men, however, and Mr. Hollingsworth says, I should judge that from 75 to 90 per cent. of the new men had it in a greater or less degree either in their first or second shift on the work, in spite of the fact that any new men on a shift were brought out of the air by their foreman or the lock tender after the other men were all out, so that they could take plenty of time. The time of decompression lasted from 12 to 15 minutes in 25 lbs. of air. On the other hand after they had gotten over their first attack it seemed next to impossible for them to get the bends again, no matter how quickly they came out, with a few exceptions. As for the exceptions noted, it seemed impossible for them to come out at any speed whatever. Some of them after coming out from work would be attacked with the bends while in the dry house and would immediately be placed in the hospital lock and the pressure run up about ½ lb. higher than the pressure under which they had been working and the

outlet valve set from the outside so that the decompression would be at the rate of about 5 minutes per pound, or about 2 hours for 25 lbs., but on coming out they would often be attacked again. The next time the time would be increased to 2½ hours and even then it would often prove useless, and we have had men that failed to get rid of it after going in the lock three or four times with hot baths and hot coffee between times. They would then be sent to the hospital and with these stubborn cases the men were not allowed to go back to work. The other workmen in spite of orders would go in and out of 25 lbs. of air from 1 to 2 minutes and feel no effects. One thing noted was that either in summer or winter a damp spell would bring on several cases of the bends. Also men that were subject to attacks of rheumatism would have a touch of the bends immediately after such an attack.

A peculiar thing was that while the atmosphere away from the locks was quite cold and that near the locks was intensely hot, the lock tenders had as much or as little of the bends as the others. The air from the compressors was discharged near the locks and there was sufficient leakage at the heading to cause considerable current and to make the air quite cool. Otherwise, the supply pipes would have been carried close to the heading.

A SOAP BUBBLE CELEBRATION

The following letter to the *Scientific American*, purporting to be from a small boy in California, makes reading of interest to various ages:

In our town of Berkeley we have a new government which will not let little boys have any fireworks on the Fourth of July. My father thought that was a good idea, but he wanted me to have a good time on the Fourth of July just the same, so he got up this experiment for me and my friends instead of fireworks.

He took about a quarter of a pint of Italian olive oil and boiled it about two hours with about four ounces of common caustic potash, such as is used for wool washing, he dissolved the potash in about half a pint of water before boiling it with the oil. After the mixture had been boiled two hours the soap was ready, and he strained the extra water and potash off after the mixture had gotten stone cold and stood over night.

The next morning, which was Fourth of July, he got the biggest dish-pan in the house, about two and one-half feet across, and he made up a solution of the soap in about four gallons of water, then he took the garden hose and fastened it to one of the larger gas pipes in the cellar and put the other end in the bowl of soap water, and then turned on the gas. The dish-pan quickly filled up with a mass of bubbles all fastened together, each bubble being about as big as my fist, and then because they were so light on account of being filled with gas they began to try to rise up, but they were so stuck to the soap water that they did not break away till there was a mass of them nearly as big as the largest sized watermelon, then they sailed away and we watched them till they were out of sight. As soon as one bunch of bubbles had sailed off another bunch began to form, and sometimes we could see as many as twenty in the air at once. Some of them we could watch as long as three and a half minutes by the watch before they went clear out of sight. We kept up the game several hours, and the amount of gas used up was 32 cents worth, which was a cheap enough Fourth of July.

A dust collecting machine for card rooms is being introduced into English factories. It is self-contained and does not require the erection of any overhead piping. It consists of a dust-collecting receptacle mounted on a trolley which can be wheeled down the alley between the cards and employed to remove the dust from each card as it is stripped. Within the dust-collecting receptacle a fan of special type is mounted. This fan is driven by a rope from the rope pulley of each card. Suitable flexible pipes are connected to the dust receptacle and can be connected to a cowl or cover surrounding the stripping brush. The inner side of the receptacle is covered with cloth, which acts as a filter, and, although allowing the induced air to escape in the atmosphere of the card-room, prevents any dust or other foreign matter from passing through. When in position the flexible pipe is connected to the cowl, or cover, and stripping commences. The dust generated by the stripping process is collected in the receptacle, the strips in the brush being removed by hand as hitherto.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

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CHARLES TALBOT PORTER

Charles Talbot Porter died at Montclair, N. J., on August 28. He was a distinguished engineer and the most recent recipient of the John Fritz medal established as a recognition of notable scientific or industrial achievement. The four men receiving this medal prior to Mr. Porter were Lord Kelvin, George Westinghouse, Alexander Graham Bell and Thomas A. Edison.

The John Fritz medal of distinction was conferred upon Mr. Porter by the four national engineering societies because of his work in perfecting the high speed steam engine. Prof. Hutton, of Columbia University, at the time this medal was conferred upon Mr. Porter, said that "the reciprocating engine owed to him the first vision of the advantages that come from making the crank shaft turn at a high number of revolutions, whereby the weight of motor per horse power is reduced. From this thought sprang the modern design of the motor for self-propelled vehicles and for the aeroplane."

Mr. Porter was born in 1829. He was the mechanical head and dictator of the Porter-Allen Engine Co. In 1867, he installed the only high speed engines exhibited at the French Exposition. He forced new ideas of speed possibilities upon the engineers of the world.

To so design an engine that the weight of motor per horse power is reduced, and at the same time to secure economy and durability, is an advance of no little importance in engine practice. As we look over the encyclopedias of mechanics and see the pictures of primitive engines, whether they be steam engines, pumps or air compressors, the first thing that impresses us is that the older the design, the heavier, more complex and slower of speed it appears to be. The old Cornish pump and the original Watt engine were slow moving, cumbersome, heavy devices. The horse power per unit of weight was small, and if efficiency means something more than low coal consumption, if it means also less material, less space occupied, requiring less attention on the part of the engineer, then the modern steam engine compared with the old is a highly efficient machine.

What has been done with the steam engine is now being done with the air compressor, which is, after all, only a steam engine applied

to the compressing of air. It was originally supposed that the efficiency of an air compressor was in direct proportion as its speed was reduced. Manufacturers called attention to the slow speed as an argument in favor of the permanency and efficiency of the machine. This was all very well during the time that steam engine practice depended upon low speeds; it was all very well when pneumatic engineers had not learned how to compress the air in stages and to cool it before, during and after compression; it was all very well before splash lubrication and the automobile system of boxed-in crank shafts and automatic oiling had been established. To-day there is no more reason why the air compressor should not be run at high speed than that a steam engine should be put back in the place it held twenty-five or more years ago. A *common* air compressor will not stand high speeds, and will not give high economy when so driven. The same may be said of a common steam engine; but an air compressor designed for speed, with large ports and passages, large bearings, approved systems of cooling, and with splash or flood lubrication, should weigh less, and it actually does produce a cubic foot of compressed air at a higher general efficiency than the old fashioned, slow speed machine.

ELECTRIC AIR A PNEUMATIC INVENTION

There is at least one curious thing about the development of the electric air channeler, and, in fact of the electric air drill also, in that while the invention as completed and applied is quite revolutionary in its character, and has made the employment of electricity for all kinds of rock cutting not only possible but highly economical and desirable, there is in the device no improvement of or addition to existing electric apparatus, and we might say, no electric invention is involved. In this case electricity has not made work for itself as in so many fields it has done, but work has been made for electricity. In both the electric air drill and the electric air channeler an ordinary electric motor is used, with the ordinarily available current, but new results are accomplished by it, and the electric air percussion rock cutter is one of the most successful of mechanical novelties in recent years.

The electric motor is used in this case with thankfulness for the existence and availability of it, but with no thanks to electric invention for developing its so successful application in this field. This is not the first instance, nor perhaps the largest field, in which pneumatic apparatus has provided employment for electricity as the ultimate motive force. The electric air drill with the electric air channeler now make it possible to employ the electric current as the sole means of power transmission for mine or quarry, and to dispense entirely with large compressor plants and long pipe lines in many cases.

It is rare indeed that new inventions develop great advantages and economies without entailing also some partially off-setting objectionable features, and the absence of the latter in the case of the electric air drill has been widely commented on. In fact no sacrifice or even compromise of any desirable working feature has followed, while the saving in power alone is indisputably demonstrated to range up to 60 and 70 per cent. at the power house.

The same characteristics of convenience and economy are emphasized and extended in the application of the electric air principle to the rock channeler. The machine as a whole is much simplified as compared with the steam channeler, or even the air actuated channeler of the older types. Instead of the motor and pulsator separate from the percussion mechanism, and requiring to be separately handled with every change of location, these do not require to be moved or looked after at all, being securely and permanently fastened upon the base of the machine and by their weight contributing to its balance and stability. Instead of the two pulsator cylinders with the two cranks to operate them for the electric air drill, there is but one pulsator cylinder and a single crank on the channeler. The one motor serves not only to operate the channeling steels but also to feed the machine along the track in either direction and the wires, which are the only power connection, permit a longer working travel than is ever required in practice.

The flexible hose, connecting, at each end of each, the pulsator with the channeling cylinder, in no way interfere with or limit the possible angular adjustments, so that the channeler is used not only for cuts vertical or nearly so but also for undercutting at an-

gles approaching the horizontal. The perfect and constant lubrication of the machine was never so well provided for. The same air being used over and over, the oil is not carried away by the exhaust, as there is none, but remains in the machine, and in fact may be considered a part of it to perform its function the same as the piston, the connecting rod or any other essential mechanical member.

The saving of power by the employment of the electric air principle in drill or channeler is so acknowledged and so familiar as to require no further mention or explanation. Perhaps the habit of time saving which also may be claimed for the devices should be more insisted upon. There is no fixed speed for the ordinary air or steam operated rock drill. It works slower and faster, and when the bit sticks there is nothing doing until the operator does something to free it. The electric air drill or channeler goes along with the rhythm of a military march. The motor and pulsator run at uniform and contant speed, and for every stroke of the pulsator there is also a stroke of the steel upon the rock. If the steel sticks, so that it does not withdraw promptly and completely from the cut, the pulsator keeps up its steady and alternating pull and thrust, and before the stoppage is realized the steel is striking steadily again. The electric air drives an express with few and short stops.

ROCK TUNNEL METHODS AND RECORDS

[The following letter, which appeared in *Engineering Record*, August 20, is entirely self-explanatory. As will be seen it follows a letter in the same columns having to do with the excellent record made at the tunnels of the Buffalo waterworks:]

Sir: Let me discuss as briefly as possible Mr. C. H. Hollingsworth's very intelligent and practical letter on rock tunnel records published in the *Engineering Record* of June 18. I share with Mr. Hollingsworth the desire to see some figures of cost in the Loetschberg tunnel records. These have not been far so available, and the main point to which I have endeavored to call attention is that by the system employed in these Alpine tunnels they have doubled the former rates of progress. There are many reasons why speed is of the greatest importance in tunnel driving. This is especially true in the case of long tunnels. At the Simplon, for instance, a large bonus was offered provided the tunnel was completed in a certain time. This bonus was so large as to warrant a considerable sacrifice of running costs to progress. The unit of cost, or the cost per cubic yard to contractor, may be greater, but the cost of the finished tunnel may be less to the railroad company, because of the shorter time required for its completion.

The contract price for the Simplon tunnel was about $12,500,000. To this should be added the preliminary construction work, or $1,500,000. Half the cost, plus the preliminary work, would approximate the average amount of money involved during construction, or $7,750,000, which at 4 per cent. would be $310,000 per annum or about $1,000 a day. This figure is equal to about $2 per cubic yard, assuming an output of about 500 cu. yd. a day, and it shows the importance of speed in a long, expensive tunnel.

The question of top or bottom heading is one which depends so much upon the nature of the rock and other conditions that no general rule can be adopted. The justification for driving a bottom heading, at an increased cost over a top heading, is the gain in speed and the facility and economy in handling soil for the full section.

The data in Mr. Hollingsworth's letter of performance in top headings of the Buffalo waterwork tunnels provides a basis of comparison with the work in the bottom headings in the Loetschberg tunnel. The following tabu-

	Buffalo.	Loetschberg.
Mucking out headings	1 hr. 35 min.	3 hr.
Setting up columns or carriage, starting drills	45 min.	40 min.
Drilling time	4 hr. 30 min.	2 hr.
Removing drill carriage or columns and loading and firing holes	50 min.	1 hr. 40 min.
Clearing out smoke	20 min.	40 min.
	8 hrs.	8 hrs.
Size of heading in feet	8 x 15	6½ x 10
Area in square feet	120	65
Number of rounds fired	1	2
Average area of face per hole drilled, sq. ft.	6⅔	5⅔
Number holes per round	18	12
Depth of holes in feet	7 to 7½	4
Size of hole at bottom, in.	1⅝?	2
Total feet drilled per shift	126-135	96
Feet drilled per drill hour	7.33	12
Powder, 60 per cent, per cu. yd., lb.	3	7?
Number of drills (Ingersoll-Rand)	4	4
Size of drill, diam. of piston, in.	3¼ (E-24)	3⅜ (P-94)
Effective air pressure at drills, lb.	95	95
Average pull per foot of drilled hole when blasted	.71	.87
Gain in pull over Buffalo, per cent	..	22.5%

lation of the different operations during an eight-hour shift at each tunnel heading shows the proportion of time and other detail.

The tabulated comparison of the Buffalo and Loetschberg tunnels shows that the heading area at Buffalo approximates twice the size of the heading at Loetschberg, that in proportion to area Buffalo has but one-third of the drill capacity. Owing to the closer spacing of holes, the larger diameter of the hole at bottom, and the very much greater quantity of dynamite used in the Loetschberg tunnel, a greater advance (22.5 per cent.) is made per foot of hole drilled.

At Buffalo, drill columns are used; at Loetschberg, a special carriage with an I-beam arranged to carry a drill bar, upon which four drills are mounted, in advance of the carriage. The intention in this arrangement was to expedite the placing and starting of the drills after blasting.

The chief point brought out by these figures seems to be that the drilling time is so much slower in Buffalo than in Loetschberg, and this is mainly due to the smaller drills at Buffalo. Had the larger drills been used (3⅝ in., same as at Loetschberg) an equally favorable showing in all respects might have been made, but here the point comes in, that in order to use a large drill properly one must have some sort of carriage, and at Loetschberg they have a very simple form of carriage, which gives them the benefit of the large drill.

A comparison of the Loetschberg with the Pennsylvania Railroad tunnel at Bergen Hill shows that in the Pennsylvania tunnel the drills were hitting the rock 25 per cent. of the total time, while at Loetschberg the evidence is given that the drills were hitting the rock 50 per cent. of the time. In the Buffalo and Loetschberg figures given here the words "drilling time" must not be taken as "hitting the rock," as drilling time includes time lost changing steels, stoppage because of bad holes, change from one place to another, etc., while hitting the rock means just what the words imply; that is, it is the time taken doing the actual work of drilling. Here we have an important point to work upon. We must, in the first place, use a large drill in order to make rapid progress, in order to use high pressure without inordinate breakage of parts. Having these large drills we should so mount them that they will be hitting the rock as much of the time as possible.

Mr. Hollingsworth criticises the statement that with a greater number of holes and greater blasts access can be made to the heading sooner than under the present system. The words "heavier blasts" do not give the meaning that I intended to convey. What is meant is that a large number of shallow holes (these holes being of large diameter at the bottom) will break up the stone to better advantage than a small number of deep holes, small at the bottom. The material will break better, will be thrown farther from the face, and will be quite sufficiently mixed up in size to facilitate loading. W. L. SAUNDERS.

FOR CENTRAL COMPRESSOR PLANTS

"The story is told, and is vouched for as being true, of a requisition that was received from a small shop on a western railway for an additional air compressor. The necessity for this could not be understood at headquarters, and the superintendent of motive power sent a member of his staff to investigate. The shop was in a district subject to extremely high temperatures, and it was found that the master mechanic, in order to rest comfortably, had installed three or four nozzles in the bedroom of his bungalow connected to the compressed air system. The turning of a valve when he retired to his room would insure a cool and comfortable night's rest. It is needless to say the air compressor was not furnished."

The above we copy from the *Railway Age Gazette*. The incident narrated speaks for itself and requires no comment. The editor however, follows it with a line of remark with which we cannot entirely agree. He says:

"This is hardly more extravagant than the practice at a number of terminals or important points of furnishing compressed air from one power plant for the repair shops, car repair yards, roundhouses and classification yards. This not only requires a large amount of extra piping, but the air pressure at the outlying points varies greatly and is not at all satisfactory. It is far better to install two or three electrically driven compressors at the more important centers of distribution. Electrical energy may be transmitted to these points from the central power plant far more efficiently than compressed air. The reduction in the length of piping reduces the cost of maintenance, especially in cold weather

when the moisture gathers and freezes in the pipe and has to be thawed out."

It is becoming the established practice, and many considerations favor it, to install in cases like this a central compressing plant for the entire system, using units as large as the circumstances will warrant, with sufficient duplication to guarantee the maintenance of service except in extraordinary contingencies. Compressed air is thus furnished more cheaply as regards both power and labor, and the air service is better in every way. If aftercoolers are used, followed by water separators, freezing up is practically eliminated. The piping should be of adequate capacity so that, say in a large railroad shop, there should be nowhere a drop of more than 5 pounds from an initial pressure of 90 or 100 pounds gage.

The large contracting engineers, as upon the New York Barge Canal or the Catskill Aqueduct, in each case depend upon a central compressing plant although the distances are several times greater than those of railroad yards. Those most familiar with properly installed and managed compressed air plants have little to say about leakage as they encounter so little of it.

AIR CURRENTS ROB MINES OF MOISTURE

The following interesting matter bearing upon the necessity of counteracting the drying effect of air currents in mines is from a paper by Erskine Ramsay before a gathering of Alabama engineers and officials:

The amount of water an air current will take out of a mine in cold weather is surprising and startling. At Banner the ventilating current amounts to 200,000 cubic feet per minute, and for the purpose of calculation the inlet and outlet will be considered of equal volume. From the tables it is found that this volume of air when saturated and at a temperature of 40 deg. F. will carry into the mine in 24 hours about 14,000 gallons of water in the shape of moisture. The same current, heated to the temperature of the mine, say 65 deg. F., will carry out of the mine about 34,000 gallons, thus robbing the mine of 20,000 gallons each 24 hours. Unless the mine is to be dried out and become dusty, this moisture must be supplied to the air current from steam jets, pools of water, hose, sprays or other means. At Banner it is sought to supply by sprays at least a part of this loss. The 31 sprays now installed will deliver about 30 gallons per hour and with all of them working, a total of over 22,000 gallons would be delivered during each 24 hours or a little more than is taken out by the current.

THE PROBLEM OF AUTOMATIC STABILITY OF AEROPLANE

It is claimed that the problem of the automatic stability of aeroplanes has been solved by Lieutenant J. W. Dunne, of Farnborough, England. At the trials the machine rose to a height of about 60 feet and then flew for a distance of about two miles without the touching of a lever or wheel, the machine during the whole time being in absolute equilibrium. The machine is a biplane, the most remarkable feature being the absence of a tail and steering surfaces or rudders of any kind, with a single exception of a couple of small steering flaps hinged to the rear extremities of the upper surface for the purpose of altering the course of the machine during the flights. The carrying planes are provided with a double curvature which, it is claimed, produces the automatic stability.

PRODUCER GAS FOR SMOKE ABATEMENT

The Sub-committee of the Glasgow City Council on Air Purification report that during June and July the smoke inspectors had made 245 inspections of boiler and other furnaces, and 2270 observations of chimneys, as a result of which 24 intimations of excess smoke had been made. Gas engines and producers are steadily being substituted for steam boilers. One firm has discarded its boilers and installed instead two engines of 50 and 60 indicated horse-power, working off one suction gas producer; another has taken out its steam engine and put in three suction gas engines, with accompanying producer plant, retaining its steam boiler for heating purposes only during the winter season. A third has installed a 60 indicated horse-power suction gas engine with producer plant, being the second engine introduced within the last eighteen months; in consequence of which three Lancashire boilers have been discarded and two chimneys rendered inactive. The Electricity Committee have decided to construct a model dwel-

ling for the purpose of showing the use of electricity for lighting, heating, and cooking, to be exhibited at the Smoke Abatement Exhibition.

NOTES

The annual per capita consumption of coal in the United States constantly increases. In 1880 it was 1.4 tons per capita; in 1892, 2.3 tons; and in 1907 it was 5.4 tons.

Experiments and observations on the decay of stone antiques in England have developed the discovery that the decay of stone work usually laid to the weather is really the work of bacilli which thrive on the chemical substances distributed in the air by soot and smoke.

A Chester, Pa., a man was killed by the blowing off of the bead ring of a detachable rim tire of an automobile wheel. The owner was pumping air into the tire and the man was seated on an embankment watching the operation when the ring flew off striking him in the face and cutting into his head so that he died in ten minutes.

The Southern Pacific Railroad has had the Baldwin Locomotive Works build for it some what would be called backward running engines, to burn oil from the California fields. The engineer and fireman are in front, like the motorman of a street car. This is possible because the tender, carrying the oil supply, does not have to be so close at hand.

Compressed air for cleaning the electric machinery in all parts of the filtration building of the Cincinnati water purification works has been made available, by the installation of a motor-driven compressor and a small air receiver in the pump room of the head-house. From the receiver a 1-in. pipe line, with suitable outlets, is run through the pipe gallery of the filter-house and into the chemical house. A flexible hose attached to outlets on the line permits the electric equipment to be cleaned readily.

The waterworks of Vienna which have been under construction for about 10 years, are now nearly completed. Supplies are derived from mountain springs and brought to the city by an aqueduct, 113 miles long, built mainly of concrete and measuring 6 ft. 10½ in. high by 6 ft. 3 in. wide. Numerous tunnels have been driven on the line of the conduit, one of them at Göstling being 3 1-3 miles long, while the total length of the tunnels aggregates nearly 53½ miles. As a general rule, valleys have been crossed by siphons with a collective length of 13 miles, but there are also about 100 bridges accounting for some 5 miles of the aqueduct.

No substance that refuses to dissolve in water has an ordor. It is the actual substance itself, floating in particles in the air, that appeals to the nose, and not simply a vibration of the air, as in the case of light and sound. The damper a thing is the more powerful the odor it gives off. A pleasant proof of the fact can be had by walking in a garden after rain. There is no end to the curiosities of smell. It is, for instance, the vapor of a liquid that smells, and not the liquid in the mass itself. If eau de cologne be poured into the nostril the nose refuses to recognize any odor there at all.

An unnamed "authority," quoted by an exchange, gives the following rather indefinite statement of losses incurred in electric generation and transmission: Loss due to friction of steam-engine, 10 per cent.; loss in belting between engine and generator, 3 per cent. If direct-connected this is not figured. Loss in generator, 10 per cent.; loss in line, 10 to 20 per cent.; depending on its length, size of conductor, care in building line, etc.; loss in motors, 12 to 20 per cent. depending on kind used and service required by them; 5 to 10 per cent. loss between the brake horsepower and the machine to be driven, to which may be added the loss in the machine itself due to friction. Total efficiency, 50 per cent., taking the lowest estimate of loss.

According to a consular report dealing with the trade of Denmark, milking by machinery has gained some ground during 1909, and about 150 machines, mostly of the pressure and suction type, are in use. At the same time, it cannot be said that this question has as yet found a satisfactory solution. Experiments have lately been in progress at a well-known Danish dairy farm, under the superin-

tendence of representatives of the Royal Veterinary and Agricultural College of Copenhagen, with a view of comparing the relative values of hand milking and milking by machinery. The milking machine under observation was the Lawrence-Kennedy-Gillies milking machine.

The deepest vertical shaft in America at any gold mine is the Kennedy, at Jackson, California, which is 3450 feet. There are deeper shafts in gold mines at Bendigo, Australia, and on the Rand, South Africa. The deepest vertical shaft in the world at present is the Tamarack No. 3, near Houghton, Michigan. It is 5253 ft. deep, lacking 27 ft. of being a mile. No. 5 shaft of the Tamarack company is 5089 ft. deep. The deepest shaft of the Calumet & Hecla mine, adjoining the Tamarack, is the Red Jacket, 4920 ft. deep.

An installation of jet cooling sprays for handling approximately 27,000 gal. of condensing water per hour is in operation at the plant of the Cambria Iron & Steel Works, Johnstown, Pa. Condensing water is pumped to the spray nozzles through a 24-in. pipe. The system comprises cooling steps and horizontal pipe made up of 20 18-in. tees, each fitted with a 1½-in. Schütte & Koerting spray nozzle. Ten of the sprays are inclined at an angle of about 30 deg. and 10 at about 60 deg. with the vertical. The cooling slope, a series of concrete steps, is 72½ ft. wide and 124 ft. long. The water leaves the jets at a temperature of 120 deg. and is taken from the reservoir at 80 deg.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

AUGUST 2.

965,881. LANDING AND STARTING APPARATUS FOR AEROPLANES. GEORGE OTIS DRAPER, New York, N. Y.

965,949. ACETYLENE-GENERATOR. FRANK C. SANFORD, Bridgeport, Conn.

965,963. BURNER FOR FUEL-OILS. ALBERT W. THOMPSON, Manchester, N. H.

1. In an oil burner, an atomizing chamber provided with a tangential inlet for the admission of air under pressure, and an axial outlet at one end of the chamber, an inlet member for oil under pressure, communicating axially with said chamber at its other end, and means to provide an annular jet of air concentric with and adjacent to the outlet of the atomizing chamber.

965,969. FLYING-MACHINE. FREDERICK H. WALES, Imperial, Cal.

966,032. HOT-AIR MOTOR. GUILLAUME MANN, Paris, France.

966,151. FLYING-MACHINE. MALCOLM GROVER ADAMS, Parsons, Kans.

966,211. AIR-BRAKE SYSTEM. CHARLES W. HURL, Altoona, Pa.

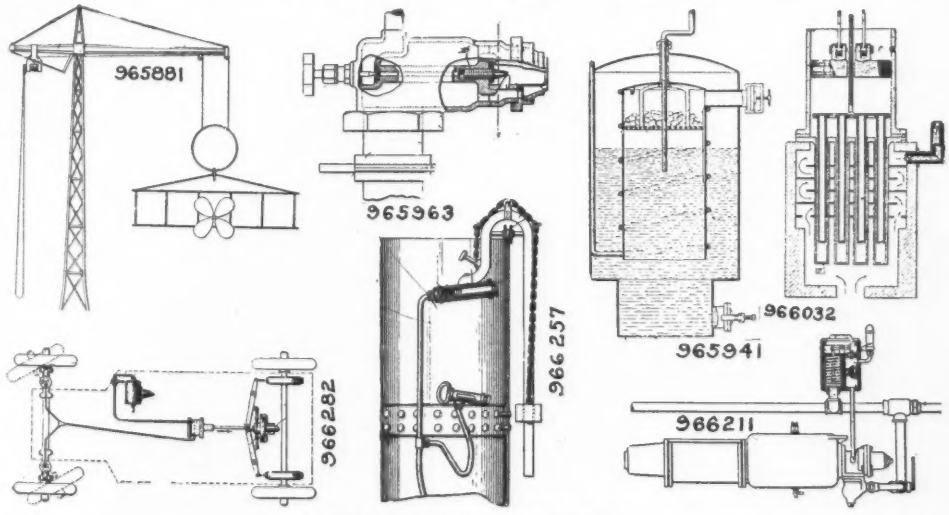
966,257. RIVET-HOLDING APPARATUS. WILLIAM T. SMITH, Birmingham, Ala.

966,282. AIR-BRAKE AND CLUTCH MECHANISM. WILLIAM B. WEST, Philadelphia, Pa.

AUGUST 9.

966,424. MONOPLANE. EVERARD H. BOECKH, Toronto, Ontario, Canada.

966,494. AIR-COMPRESSOR. GUSTAV C. VOLLMER, St. Louis, Mo.



PNEUMATIC PATENTS, AUGUST 2.

966,574. MACHINE FOR MAKING BUTTER. RODNEY MONTAGUE, Cincinnati, Ohio.

1. In a machine for making butter, a closed cylindrical vessel, having a central rotatable hollow shaft, with a series of air tubes radially projecting from the lower end of said shaft, and extending to the wall of the vessel, the lowermost air tubes having openings throughout their length opening downwardly to project the air against the bottom of the vessel and the uppermost tubes having openings at their outer ends to project the air against the side wall of the vessel, an air pump for forcing air through said shaft and air tubes and means for rotating said shaft and air tubes.

966,576. LIQUID-FUEL BURNER. WALTER R. MONTGOMERY, Shreveport, La.

966,628. BURNER FOR LIQUID FUEL. CARL W. WEISS, New York, N. Y.

2. A fuel oil burner comprising an annular flame guard provided with a tangential spray inlet port through which air and oil are supplied, and with lateral flame outlet ports, means to discharge additional air into the flame guard, means to supply oil under pressure in a liquid condition, and a spray jet nozzle to direct the oil spray under pressure into the spray inlet.

966,710. PNEUMATIC STACKER. JOSEPH K. SHARPE, Jr., Indianapolis, Ind.

966,864. PNEUMATIC SUPPORTING MEANS. GUSTAF VON SCHANTZ, New Britain, Conn.

966,911. AIR-FEED FOR DRILLS. MARTIN HARDSOCG, Ottumwa, Iowa.

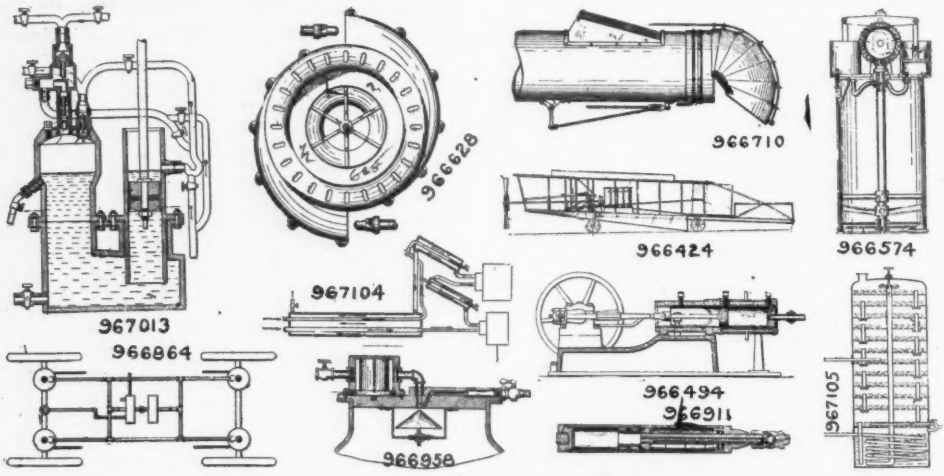
966,958. MILKING APPARATUS. FRANK B. SHAFER, Northville, Mich.

967,013. AIR-COMPRESSOR ADAPTED TO WORK AS A VACUUM-PUMP. ELIE GAUCHER, Constantinople, Turkey.

967,104. PROCESS OF LIQUEFYING GASES. GEORGES CLAUDE, Paris, France.

967,105. PROCESS FOR THE SEPARATION OF GASEOUS MIXTURES INTO THEIR ELEMENTS. GEORGES CLAUDE, *Nogent-sur-Marne*, and RENE JACQUES LEVY, Boulogne-sur-Seine, France.

4. A process for separating atmospheric air into its constituents, which consists in liquefying cold compressed air in a vaporizing compartment containing the liquid oxygen or liquid rich in oxygen which results from the separation, and is thereby vaporized, causing the liquid resulting from the said liquefying of the cold compressed air to descend by stages into the said vaporizing compartment, conducting part of the vapors ascending therefrom in the opposite direction to and in contact with the descending liquid to progressively enrich it in oxygen by the substitution of the oxygen of the vapors for the nitrogen of the liquid, and adding a cold gaseous mixture of oxygen and nitrogen, poorer in oxygen than the vapors immediately above the liquid in the vaporizing compartment, to the ascending vapors, at a point where they are of approximately the same composition as the aforesaid gaseous mixture, and at a pressure only sufficient to enable it to ascend, together with the aforesaid vapors, through the descending liquid.



PNEUMATIC PATENTS, AUGUST 9.

967,271. PNEUMATIC MOTOR. EUGENE T. TURNEY, Rock Island, Ill.

967,285. SHOCK-ABSORBER. CHRISTIAN WILSON, Brookline, Mass.

967,286. APPARATUS FOR AERATING LIQUIDS. JACKSON B. YOUNG, Oakland, Cal.

967,359. FLYING-MACHINE. ALBERT HUGO FRIEDEL, Baltimore, Md.

967,513. VACUUM AUTOMATIC MILKING-MACHINE. FLOYD B. GROFF, St. Johnsville, N. Y.

967,516. AUTOMATIC AIR-COUPLING. ARCHER H. HARRISON, Orange, La.

967,711. AEROPLANE. ROMAIN DE BERSAQUES, Washington, D. C.

967,731. SAFETY-VALVE FOR AIR-BRAKES. THOMAS B. COYLE, Ashley, Pa.

AUGUST 16.

967,199. AUTOMATIC AIR-PUMP. JAMES A. KENWORTHY, Oakland, Cal.

967,234. FLUID-PRESSURE REGULATOR. THOMAS S. PUKERUD, Pittsburg, Pa.

967,239. FLUID-OPERATED ROCK-DRILL. CHARLES B. RICHARDS, Cleveland, Ohio.

967,245. ELECTRICALLY-OPERATED CONTROL MECHANISM FOR PNEUMATIC OPERATING DEVICES. HAROLD ROWNTREE, Chicago, Ill.

AUGUST 23.

967,885. MINING-MACHINE. CHARLES E. DAVIS, Chicago, Ill.

967,993. DUSTING APPARATUS. FRANK C. STEVENS, North Andover, Mass.

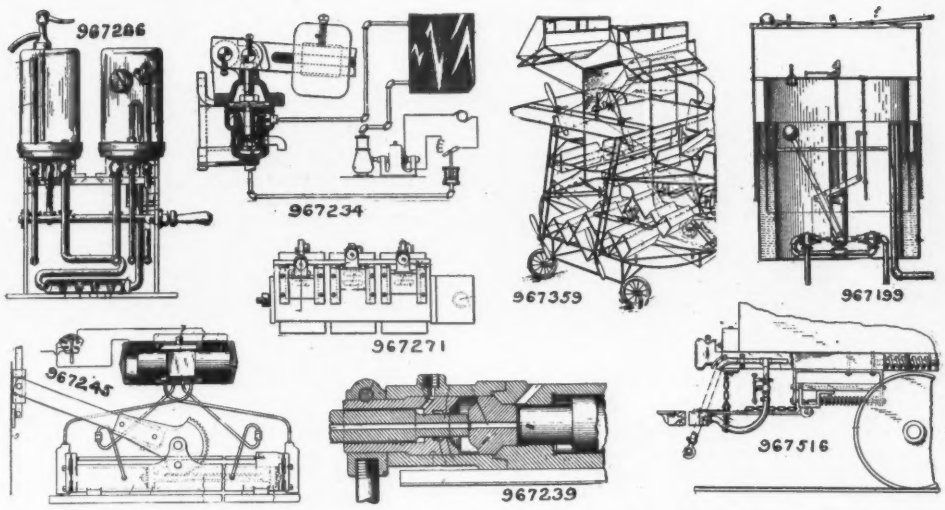
968,003. WINDMILL. ROBIN W. VAUGHAN, Los Angeles, Cal.

968,074. HUMIDIFYING APPARATUS. FREDERICK W. PARKS, Fitchburg, Mass.

968,094. COUPLING FOR AIR-BRAKE SYSTEMS. VIRGIAL P. TAYLOR, Richton, Miss.

968,120. FLYING-MACHINE. JACOB H. BUSS, Saltillo, Tenn.

968,141. PNEUMATIC-DESPATCH-TUBE APPARATUS. EDMOND A. FORDYCE, Boston, Mass.



PNEUMATIC PATENTS, AUGUST 16.

968,234. AIR - COMPRESSOR. FREDERICK BOERCKER, St. Louis, Mo.

968,236. PNEUMATIC HAMMER. JOSEPH E. BURTLE, Springfield, Ill.

968,291. PNEUMATIC ACTION. BARTHOLOMEW T. TREAHY, Detroit, Mich.

968,332. AIR-TREATING MACHINE. CHARLES E. W. DOW, Boston, Mass.

968,339. AEROPLANE LAUNCHER AND LANDER. GERALD GERALDSON, Newcastle, Cal.

2. In an aeroplane launching and landing apparatus, an oscillatory suspending element, and pneumatic means connected with said element to permit paying out of and for taking up the same, said pneumatic means being adapted to act as a cushion on the paying out motion.

968,453. ELECTROFLUID-PRESSURE APPARATUS. CARL R. DAELLENBACH, Braddock, Pa.

AUGUST 30.

968,528. METHOD OF GENERATING OXYGEN. ANDRE BELTZER, Bridgeport, Conn.

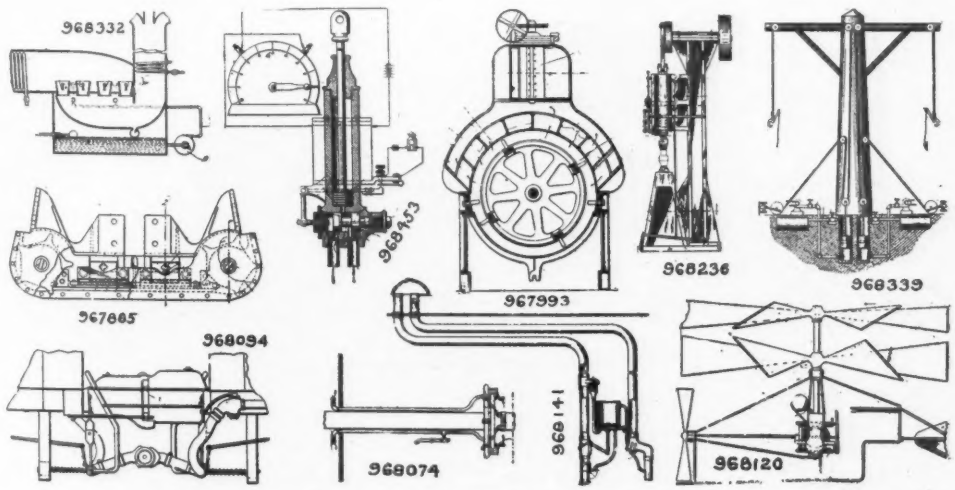
1. The method of generating oxygen which consists in heating a mixture of 66⅔ per cent. by weight of bleaching powder and 33⅓ per cent. by weight of slacked lime to a temperature of approximately 300 degrees C., substantially as described.

968,546. PNEUMATIC ACTUATING UNIT. LAMARTINE M. FRENCH and WILLIAM M. O'BRIEN, Chicago, Ill.

968,560. MOLDING-MACHINE. MARTIN L. HEYL and JOHN J. LAWLOR, Zelienople, Pa.

968,567. TERMINAL FOR PNEUMATIC-DESPATCH TUBES. CHESTER S. JENNINGS, Brookline, Mass.

968,576. PNEUMATIC-DESPATCH-TUBE APPARATUS. CHARLES R. LIBBY, Lowell, Mass.



PNEUMATIC PATENTS, AUGUST 23.

968,577. AUTOMATIC SWITCH FOR PNEUMATIC - TUBE APPARATUS. ISAAC W. LITCHFIELD, Boston, Mass.

968,580-1. PNEUMATIC - DESPATCH - TUBE APPARATUS. JAMES G. MACLAREN, Weehawken, N. J.

968,598. PNEUMATIC-DESPATCH-TUBE APPARATUS. ALBERT W. PEARSALL, Lowell, Mass.

968,607. PNEUMATIC PAD FOR HORSE-COLLARS. WALTER AVERY SKILLMAN, Springfield, S. D.

968,614. PNEUMATIC CARRIER - SEPARATOR. HAROLD D. WATERHOUSE, Quincy, Mass.

968,642. BELLOWS-LIKE HYDRAULIC AND PNEUMATIC MACHINE AND APPARATUS. PIERRE BRANDT, St. Petersburg, Russia.

968,700. FLYING APPARATUS. JULIUS SCHULKE, Jena, Germany.

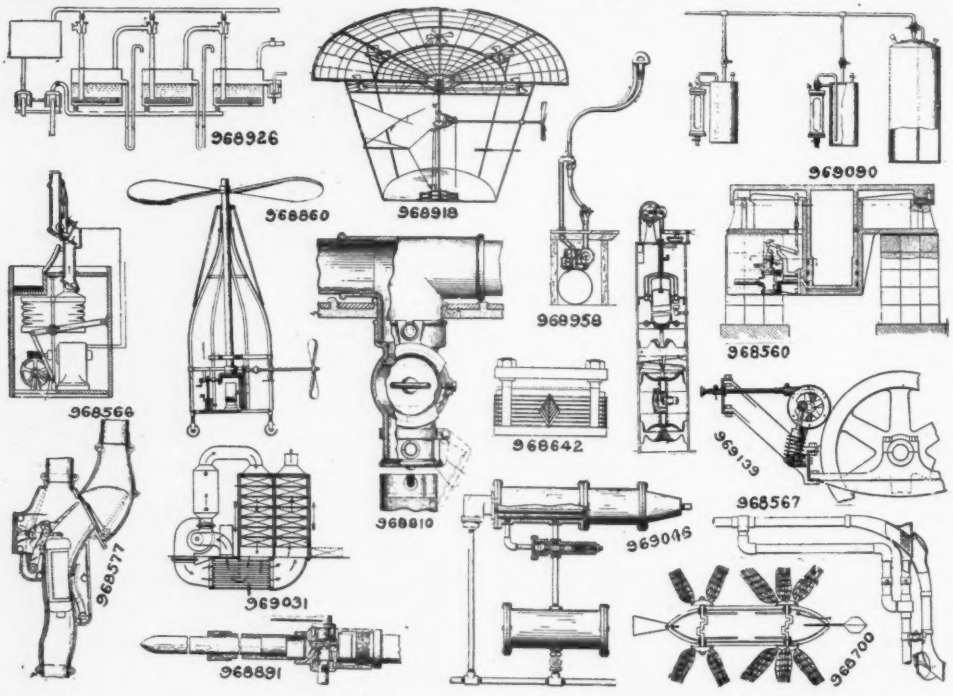
968,732. TIRE-PUMPING ATTACHMENT FOR AUTOMOBILES. OSCAR M. BERGSTROM, Minneapolis, Minn,

1. The method of compressing gas which consists in raising its pressure in successive stages by acting on the gas with a steam jet to impart velocity to the gas and then converting the energy of velocity of the gas into energy of pressure at each stage, and in condensing the steam employed at each stage, and separating the condensed steam from the gas before delivering the latter to the following stage.

969,031. PROCESS OF AND APPARATUS FOR DRYING WET MATERIAL. WLADISLAUS BRATKOWSKI, Berlin, Germany.

1. The herein described process of drying material consisting in forcing a current of air in a cycle through the material to be dried, imparting heat to the air just before it enters the material, transferring heat from the air as it leaves the material to a second current of air, and passing said second current through another portion of the material after the transfer.

969,046. AIR-BRAKE SYSTEM. ARTHUR DOAN, Elmhurst, Cal.



PNEUMATIC PATENTS, AUGUST 30.

968,734. AEROPLANE FLYING-MACHINE. JOHN M. BIGGS, Dayton, Ohio.

968,810. CONNECTION FOR PNEUMATIC APPARATUS. IRA H. SPENCER, Hartford, Conn.

968,860. FLYING-MACHINE. FREDERICK B. KUMMER, Sheboygan, Wis.

968,861. PNEUMATIC-VALVE MECHANISM. KNUT IVAR LINDSTROM, Nykvarn, Sweden.

968,891-2. HAMMER-DRILL. ALBERT H. TAYLOR, Easton, Pa.

968,898. APPARATUS FOR FILLING BOTTLES WITH AERATED LIQUIDS AND BEVERAGES. HUBERT LESLIE JOHN TORPY, Jolimont, Melbourne, Victoria, Australia.

968,918. FLYING-MACHINE. CHARLES E. S. BURCH and FREDERICK R. BURCH, Seattle, Wash.

968,926. METHOD OF AND APPARATUS FOR COMPRESSING GAS. ADALBERT W. FISCHER, Philadelphia, Pa.

969,073. OXYGEN-BATH. OTTO B. MAY, New York, N. Y.

1. A composition of matter of the character described, comprising means adapted, on contact with water, to set free hydrogen peroxid, a catalytic agent adapted to break up the hydrogen peroxid, and a finely divided insoluble inert carrier which is impregnated with said catalytic agent, said carrier adapted, upon chemical action between said peroxid and said catalytic agent, to retain said catalytic agent and prevent objectionable precipitation thereof and disagreeable discoloration of the bath liquid.

969,090. LIQUID MEASURING AND FILLING APPARATUS. GEORGE W. R. CULBERTSON and SYLVANUS R. CLARK, Glezen, Ind.

969,123. APPARATUS FOR COMPRESSING ELASTIC FLUIDS. CLAUDE HOUSTON STUART and CHARLES SCOTT-SNELL, London, England.

969,139. AIR - COMPRESSOR. JOSEPH W. EBERMAN, Chicago, Ill.

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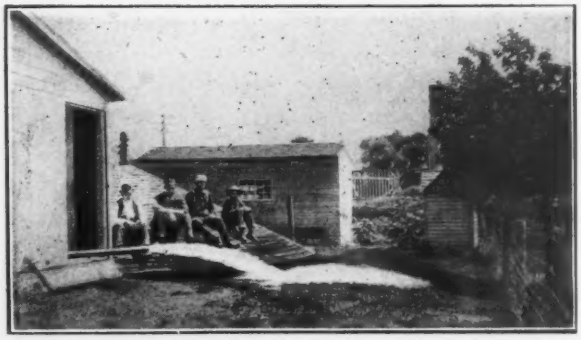

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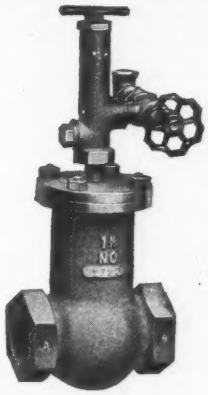

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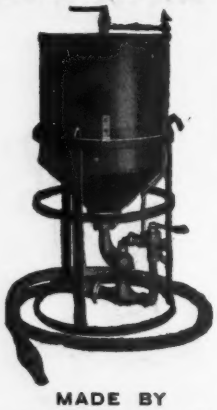

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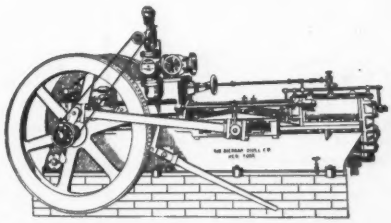

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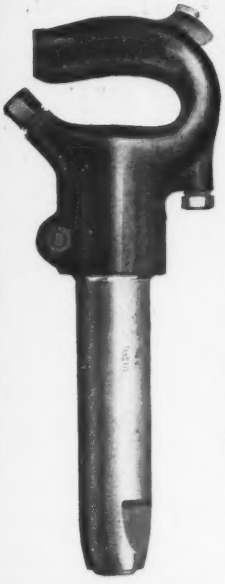

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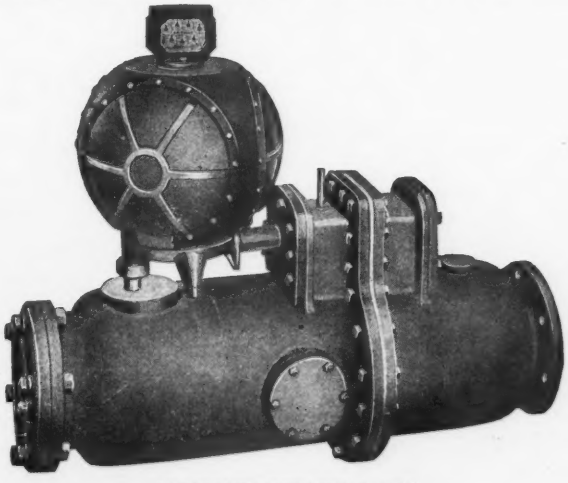

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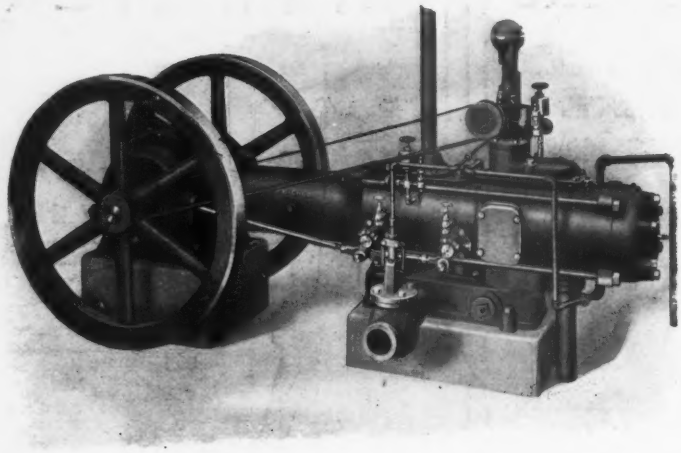

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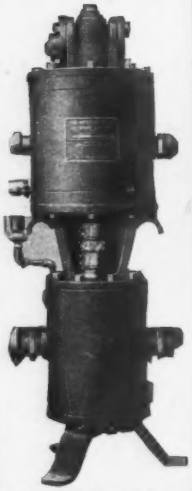

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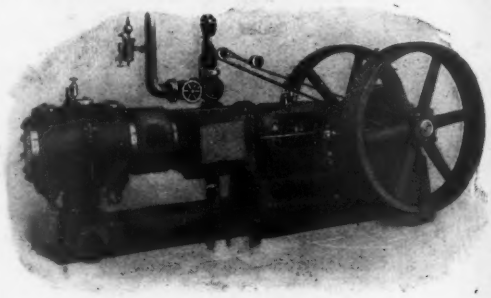

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